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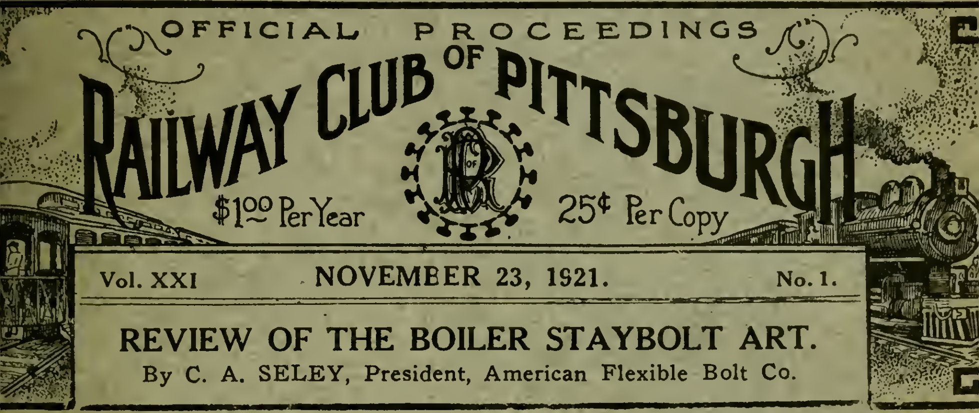
OFFICIAL PROCEEDINGS
RAILWAY CLUB OF PITTSBURGH
$1.00 Per Year — 25¢ Per Copy
Vol. XXI NOVEMBER 23, 1921. No. 1.

REVIEW OF THE BOILER STAYBOLT ART.

By C. A. SELEY, President, American Flexible Bolt Co.

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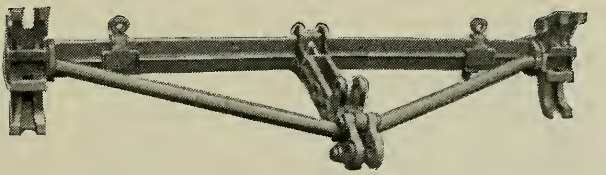

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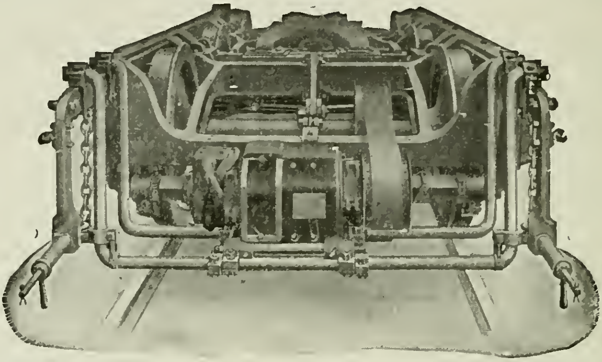

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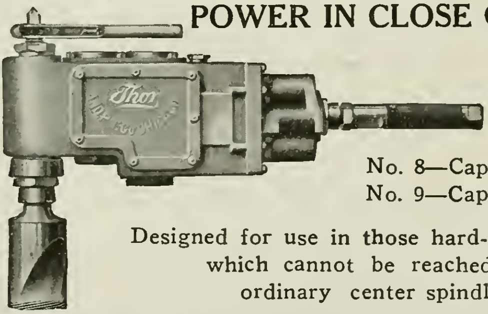

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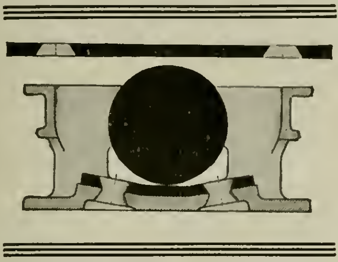

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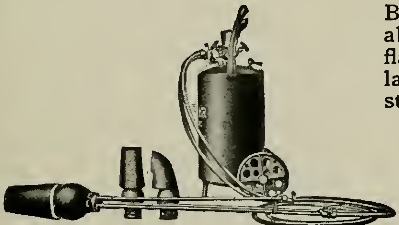

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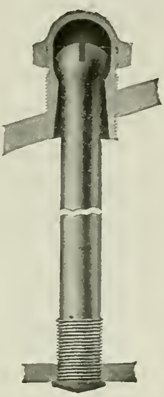

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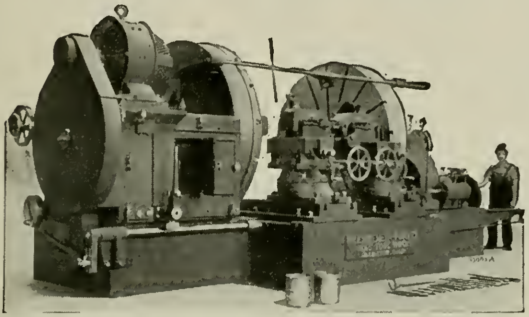

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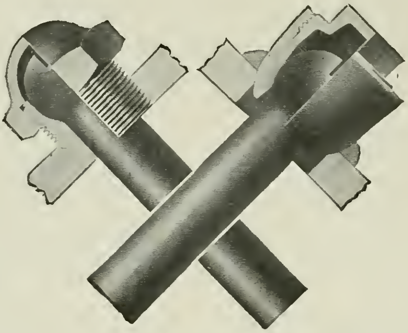

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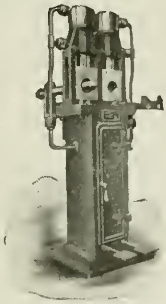

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No. 1

Pittsburgh, Pa., Nov. 23, 1921

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*H. W. WATTS	November,	1907,	to	April,	1908
D. J. REDDING	November,	1908,	to	October,	1910
F. R. McFEATTERS	November,	1910,	to	October,	1912
A. G. MITCHELL	November,	1912,	to	October,	1914
F. M. McNULTY	November,	1914,	to	October,	1916
J. G. CODE	November,	1916,	to	October,	1917
D. M. HOWE	November,	1917,	to	October,	1918
J. A. SPIELMANN	November,	1918,	to	October,	1919
H. H. MAXFIELD	November,	1919,	to	October,	1920
F. J. LANAHAN	November,	1920,	to	October,	1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
NOVEMBER 23, 1921.

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock, P. M., President Samuel Lynn in the chair.

The following gentlemen registered:

MEMBERS

Alexander, J. R.
Anderson, A. E.
Antes, Edwin L.
Babcock, F. H.
Beegel, F. W.
Berg, Karl
Bird, W. Gibson
Blakley, T. M.
Brewer, G. D.
Briggs, L. M.
Burnside, C. J.
Chilcoat, H. E.
Clark, Harvey
Code, J. G.
Conway, J. D.
Courtney, Harry
Crawford, D. F.
Daly, P. J.
Dambach, C. O.
Damore, S. A.
Dietrich, O. M.
Donovan, J. J.
Durant, C. H.
Emery, E.
Ferren, Robert O.
Fitzsimmons, E. S.
Forbes, T. E.
Forrest, C. H.
Gilg, Henry F.
Gillies, W. F.
Glenn, J. H.
Goda, P. H.
Haines, W. L. R.
Hale, Chas. E.
Harney, E. L.
Herron, B. J.
Hoffman, C. T.
Hornbeck, W. E.
Howe, D. M.
Hudson, W. L.
Johnson, A. B.
Johnson, John F.
Jungbluth, Adolph
Kelly, H. B.
Kempf, G. P.
Kirkpatrick, H. F.
Kranse, H. A.
Kroske, J. F.
Kummer, J. F.
Lake, Albert H.
Lobez, P. L.
Lynn, Samuel
Maliphant, C. W.
Matchett, H. K.
Millar, C. W.
Mitchell, J. Wallace
Moyer, Oscar G. A.
Myers, W. H.
Olsson, N. A.
Painter, Joseph
Passino, F. J.
Patmor, H. F.
Perry, G. M.
Price, W. F.
Ramsey, R. S.
Read, S. C.
Reynolds, D. E.
Rhoads, G. A.
Richardson, H. R.
Rimmel, C. C.
Ritts, W. H.
Rush, Benj. H.
Sattley, E. C.
Searles, E. J.
Seley, C. A.
Smith, J. L.

Smith, John L.
Snyder, Jos.
Steen, W. E.
Straub, W. C.
Stucki, A.
Waggoner, R. E.
Watson, John
West, John W.
Wolf, H. M.
Wright, John B.
Wyke, J. W.

VISITORS

Antal, J. J.
Bennett, Grove
Bergman, O.
Bollinger, W. A.
Campbell, N. K.
Capps, O. B.
Carter, J. D.
Code, C. J.
Estell, J. A.
Feeley, J. D.
Frannberg, A. M.
Heacock, W. F.
Heinle, A. W.
Lester, C. E.
Mahan, W. C.
Neuhausen, D. E. W.
Rodgers, J. W.
Rush, J. E.
Searles, E. R.
Smith, Sion B.
Smith, W. L.
Thomas, W. J.
Wilson, S. C.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Africa, John H., Assistant Foreman Mach., Pennsylvania System, 316 Second Street, Pitcairn, Pa. Recommended by J. L. Cunningham.

Altman, C. M., Assistant General Foreman Freight Car Inspectors, Pennsylvania System, Pitcairn Shop, Pitcairn, Pa. Recommended by J. L. Cunningham.

Brendlinger, M. T., Gang Foreman Machinist, Pennsylvania System, Lock Box 237, Pitcairn, Pa. Recommended by J. L. Cunningham.

Brumble, William E., Representative Nathan Manufacturing Co., 21 East 40th Street, New York City. Recommended by R. M. Long.

Carpenter, H. D., Motive Power Inspector, Pennsylvania System, 55 Cobb Avenue, Ingram, Pa. Recommended by Chas. J. Chester.

Carter, John D., General Agent Traffic Department, Union Pacific System, 7026 Jenkins Arcade, Pittsburgh, Pa. Recommended by E. Emery.

Courson, C. L., General Foreman, Car Inspector, Pennsylvania System, Box 428, Pitcairn, Pa. Recommended by J. L. Cunningham.

DeVou, James L., Erecting Manager, American Bridge Co., 1525 Frick Building, Pittsburgh, Pa. Recommended by Wm. H. Connell, Jr.

Eberle, Fred H., Clerk, P. & L. E. R. R., Glenwillard, Pa. Recommended by E. S. Murphy.

Fischer, Geo. E. A., Clerk, Union R. R., 518 Fourth Street, Braddock, Pa. Recommended by W. C. Bradley.

FitzSimmons, E. S., Manager Sales, Flannery Bolt Co., Vanadium Building, Pittsburgh, Pa. Recommended by J. A. Ralston.

Forester, J. A., Storekeeper, Pennsylvania System, 544 Peeples Street, Wilkinsburg, Pa. Recommended by J. L. Cunningham.

Fultz, John H., Assistant Cashier, Pennsylvania System, 425 Pennsylvania Station, Pittsburgh, Pa. Recommend by J. D. Conway.

Goho, L. G., Assistant Foreman, Pennsylvania System, 351 Second Street, Pitcairn, Pa. Recommended by J. L. Cunningham.

Grove, Joseph P., Chief Clerk, Pennsylvania System, 611 Trenton Avenue, Wilkinsburg, Pa. Recommended by W. L. Hudson.

Harkness, W. S., Foreman, Pennsylvania System, 511 Second Street, Pitcairn, Pa. Recommended by J. L. Cunningham.

Hazlett, H. H., Clerk, P. & L. E. R. R., 1530 Garfield Avenue, N. S., Pittsburgh, Pa. Recommended by H. R. Richardson.

Harshberger, W. J., Assistant Foreman, Pennsylvania System, 528 Sixth Street, Pitcairn, Pa. Recommended by J. L. Cunningham.

Horan, John A., Gang Foreman, Pennsylvania System, Pitcairn Car Shops, Pitcairn, Pa. Recommended by J. L. Cunningham.

Jackson, F. E., Assistant to Treasurer, Pennsylvania System, 425 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. D. Conway.

Jones, Ernest A., Clerk, P. & L. E. R. R., 334 Columbia Avenue, West View, Pittsburgh, Pa. Recommended by H .R. Richardson.

Kavanagh, D., Storekeeper, Union Railroad, Highland and Fairview Avenues, Turtle Creek, Pa. Recommended by W. C. Bradley.

Kearney, J. W., Superintendent, Canton Car Co., Canton, Ohio. Recommended by G. P. Kempf.

Kegel, R. C., Special Agent, Pennsylvania System, 512 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. D. Conway.

Kraft, Clyde E., Clerk, Pennsylvania System, 211 Linden Avenue, Sharpsburg, Pa. Recommended by W. L. Hudson.

Leath, Otway E., Lubrication Expert, National Refining Co., 1404 E. Ninth Street, Cleveland, Ohio. Recommended by G. P. Kempf.

Lewis, Malcolm F., Assistant Chief Clerk, Pennsylvania System, 818 Laschall Street, Pittsburgh, Pa. Recommended by W. L. Hudson.

Lichtenfels, Philip H., Foreman, Pennsylvania System, 414 Third Street, Pitcairn, Pa. Recommended by J. L. Cunningham.

Lingle, S. E., Gang Foreman, Pennsylvania System, 926 Lincoln Avenue, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Logan, Francis M., Chief Smoke Inspector, Pennsylvania System, 4815 Liberty Avenue, Pittsburgh, Pa. Recommended by John Beswick.

Loshbough, L. C., Mechanical Engineer, Ft. Pitt Steel Casting Co., McKeesport, Po. Recommended by J. D. Conway.

Mitchell, Thos. J., Vice President and General Manager, Standard Inspection Co., 1617 Falck Avenue, N. S., Pittsburgh, Pa. Recommended by W. J. Murphy.

Morrow, H. C., Gang Fore., Penn. System, 783 Sixth St., Pitcairn, Pa. Recommended by J. L. Cunningham.

Morse, L. A., Master Painter, Pgh. Div., Penna. System, 422 Second St., Pitcairn, Pa. Recommended by J. L. Cunningham.

McCormick, Louis P., Gang Fore., Penna. System, 7011 Idlewild St., Pittsburgh, Pa. Recommended by J. L. Cunningham.

McDermitt, W. W., C. C., Penna. System, 619 Kelly Ave., Wilkinsburg, Pa. Recommended by J. L. Cunningham.

Phillips, William H., Engineman, Penna. System, 528 S. Winebiddle Ave., Pittsburgh, Pa. Recommended by W. L. Hudson.

Redman, J. Thomas, Asst. Car Fore., Union R. R., 99 Hazelwood Ave., Pittsburgh, Pa. Recommended by M. E. George.

Robinson, R. L., Asst. Purch. Agt., P. & W. Va. Ry., 3433 California Ave., Pittsburgh, Pa. Recommended by G. P. Kempf.

Rude, Vance E., Clerk, Penna. System, 320 Elysian St., Pittsburgh, Pa. Recommended by W. L. Hudson.

Shiring, C. R., Inspector, W. A. B. Co., 1100 Maple Ave., Wilmerding, Pa. Recommended by A. A. Mackert.

Smith, W. L., Trav. Salesman, Sterling Equipment & Supply Co., 703 Empire Bldg., Pittsburgh, Pa. Recommended by W. H. Ritts.

PRESIDENT: As soon as these applications have been approved by the Executive Committee the gentlemen will become members upon payment of the year's dues.

Announcement was made of the death of three of our members as follows: F. V. McDonnell, Master Mechanic, Pennsylvania System, died April 26, 1921; C. S. Prosser, Manager Railroad Department, United States Rubber Company, died October 26, 1921; J. B. Rider, Vice President and General Manager, Pressed Steel Car Company, died November 3, 1921.

PRESIDENT: Appropriate memorial will appear in the Official Proceedings of the Club.

There being no further business, Mr. C. A. Seley, President of the American Flexible Bolt Company was introduced and presented the paper of theh evening.

REVIEW OF THE BOILER STAYBOLT ART.

By C. A. SELEY, President, American Flexible Bolt Co.

The subject of staybolts for steam boilers is not a new one, therefore the remarks to be made will be in the nature of a review of the later development of the art. Not all steam boilers are afflicted with staybolts, if I may use that derogatory term, borrowing it from such eminent authority as the United States Navy, whose officers do not favor such designs of boilers as would require staybolts, preferring water tube types, generally speaking, with tubes, headers and drums so arranged as to avoid use of staybolts.

In the Merchant Marine, however, this is not the case and the Scotch boiler particularly obtains, in which staybolts are required for staying flat surfaces of the furnace combustion chambers. Box headers of water tube type boilers are used extensively on land and sea service which requires staybolts, but the locomotive type boiler requires the largest proportion of staybolts of any, due to the large proportion of flat surfaces to be stayed.

In our day there has been attempts to utilize designs of sectional firebox construction which would avoid use of staybolts but apparently have not been successful, practically nor commercially, although no efforts were spared to develop the type. Some years ago there was an attempt to utilize the corrugated type of furnace, common in marine practice in locomotive boilers, but the disadvantages of limited firebox and grate areas were not as well understood in those days as in later years or the thing would never have been born, and as it was its life was short and the mourners were few.

Just a word in review as to materials for staybolts. The quite general practice of copper fireboxes and copper or bronze staybolts which has and still obtains abroad, has not been favored in our Country where steel for sheets and iron for bolts is the usual practice for locomotive boilers. On account of price and the wonderful properties obtained in modern alloyed steels, having extremes of strength and ductility, great vibratory performance in laboratory machines, properties apparently most desirable for staybolts-certainly deserves consideration for this wonderful material. Under the U. S. Marine Boiler Inspection Rules steel is permissable and is used to considerable extent. One reason is that service stresses in ordinary and usual marine boilers are by no means as severe as in a locomotive. At the same time the old marine engineer will tell you that if he can replace troublesome steel staybolts with iron ones, the trouble ceases. Steel for staybolts for locomotives has never gone beyond the experimental stage in this Country, to our knowledge, for very good and sufficient reasons. These reasons are mainly the manner of breakage. Due to the homogenity of the material the fracture is not progressive so as to give warning. One bolt breaking is likely to set off others in its vicinity, thus breaking in bunches and creating a very unsafe condition, not as readily under control as is the case with iron staybolts in which fractures are progressive.

The successful material judging from the general practice of builders and users of locomotives in this Country, is well built and properly manufactured iron and very adequately covered by specifications approved by the Mechanical Section of the A. R. A., formerly the American Railway Master Mechanics Association.

One lesson that the mechanical man in any line has to learn is that if a thing breaks it should not necessarily be made bigger. It may be too big and fail on account of stiffness and rigidity for the service it has to do. This is a conclusion well illustrated in maintenance of staybolts.

Due to the severity of service conditions, a locomotive boiler at one moment may be developing a thousand H. P. or over, followed by a sudden cessation of demand, causing maximum variations in firebox temperature in various parts of the box. Dumping of fires and rapid and uneven cooling down; washing and water changing; rapid firing up; extreme external temperature conditions; all contribute to relatively unequal movements of various parts of the firebox and combustion chamber with reference to the outer wrapper sheets and shell. It has been well stated that a locomotive firebox except when cold, is a constant vibrating machine acting on the staybolts.

Here then is the element of service that demands greatest consideration. It is easy enough to determine the spacing, pressure per square inch and the total static load on any staybolt and arrive at the proper dimensions to fulfill safety and statutory requirements. That work is done before the locomotive is built. After going into service it may not be many months or years before there is cause for staybolt renewal. It is so easy to run in the next larger size staybolt tap to renew the threads in the sheet that the staybolts grow rather rapidly sometimes, and the short life and unsatisfactory service of over-grown staybolts have, on many roads, now led to placing a limit, after which staybolt holes and sizes must be reduced by welding down, bushing or use of new sheets. This was and is particularly desirable with the so-called rigid staybolt, ordinarily threaded full length, which, when well over-grown is a vicious lever to buckle, work, crack and retire the firebox sheets, causing a renewal at high cost and loss of serviceability. Before the firebox surrenders it may break a lot of staybolts and the bigger they are the quicker they break, adding to expense and loss of engine service.

It is well known and understood that 99% plus of the breakage of ordinary rigid staybolts occurs at the end close to the inner surface of the outside sheet and in order to detect these readily these outer ends are drilled with a telltale hole, at least 1¼ in. deep, to comply with I. C. C. Boiler Rules, this depth extending generally ¾ in. or well beyond the usual point of fracture and usually announces a fractured or broken bolt by leakage in case it is not previously detected by hammer test.

In order not to have to tear down brick work in oil burners or arches every thirty days, or in the case of staybolts located in places inaccessible for convenient inspection and hammer test, the I. C. C. Rules permit use of staybolts with a tell-tale hole throughout their length. This is a measure of convenience and safety but does not contribute to an increase of life or reduction of breakage as compared with a rigid bolt with short tell-tale hole, nor should it relieve the necessity for monthly inspection in the case of hollow bolts so located as to be available for hammer test.

The location of breakage of rigid bolts has directed attention towards means of reducing failures by various expedients. Turning off the threads between the sheets has been practiced to some extent, the idea being that the reduction of body size gained thereby will reduce the rigidity, but as the outer or better portion of the iron was removed in the threading and turning, and as the body could not be made much if any smaller than the diameter at the roots of the threads, at least in the initial installation, the expense of the material thus wasted and of the time to remove it raises a question as to the expediency and real value of the operation.

It would seem a better plan to directly forge the body of the staybolts between the threaded ends to a minimum diameter consistent with stress requirements, and as larger threaded ends are required by reason of renewals and repairs of fireboxes, maintain such minimum body diameter in the interest of economy of material and reduction of the leverage effect on the firebox sheets. Such forging can be done and maintain the original structure of the various builds of staybolt iron, thoroughly protecting continuity of its lines in junctions of the body with such end shapes as are required for the various types of staybolts, whether for the water spaces or crown.

The files of the Patent Office disclose many devices calculated to overcome the breakage which seems inherent in fully threaded rigid bolts, but few of them have attained practical and commercial success. Most of these include utilizing the link, ball and socket, diaphram, and other modifications of outer end connection to attain their object, with more or less of success, however accompanied by complications and expense, which, if justified or not, is no part of this discussion. The main thing disclosed is the fact that it is now more generally recognized that staybolts materially larger than stress requirements call for are mechanically wrong and contribute, not only to their own early failure but to very extensive repair and renewal of fireboxes, a vastly more important feature than of staybolts in cost and engine availability. Bearing this in mind the manner of the outer end connection seems of less importance than the action of the body and inner end connection, with reference to the main question of expense, application, maintenance and locomotive availability.

So far have been speaking with water space staybolts mainly in mind, with but slight reference to crown stays. It has been customary for some years to employ the so-called button head stay for some rows each side of the center of the crown sheet of locomotive boilers. This design of bolt has a button or collar bearing against the under side of the sheet in addition to a taper threaded body screwed into the sheet. The object of the design is to safe-guard the crown or high part of the firebox in case of low water, as against the likelihood of straight threaded, hammered-over bolts pulling through in the event of being overheated.

The button head design presents some difficulties in its making and application. Some cases have been known of the button heads pulling off and an etching disclosed that the material had been mush-roomed, so to speak, in such a way as not to give full value of the forging. The relatively large body of the button head gets overheated as it cannot readily transmit its heat to the water, so much so, that in oil-burning locomotives the intense firebox temperature forbids their use. Due to this a taper head radial has been developed which is simple and serves the purpose and incidentally does away with a serious disadvantage of the button head type in application.

It is obviously difficult to accomplish two fits at the same time, that is, to have the threaded fit tight in the sheet simultaneously with proper fit of the face of the button head against the sheet. Assuming they are not, which is often the case, it becomes a caulking job to get them tight, often repeated after the engine is in service, as the over-heating of the mass of the head expands it and breaks the caulking joint, making a high cost of maintenance of the button head type. By omitting the button portion, increasing the taper of the threads to 1½ in. or 2 in. in 12 in. and heading over, these troubles are largely done away with.

A committee of the Master Boiler Maker's Association has made a very excellent report in their 1921 issue, recommending this type of crown stay, giving the result of test and very convincing reasons for its adoption and use. They wind up their report by suggesting that the five rows of radials, next to the back flue sheet be applied without the taper, so that in case of low water these few bolts may let go and relieve the pressure while the rest of the crown sheet with the taper radials would hold.

The taper head radial can be screwed in to a good fit; the sharper taper and heading over affords a safe holding up of the sheet; the heading over does not make a mass of metal that can be over-heated and expanded, and in every way the taper head radial seems to be a decided improvement as has been found on many roads.

If, as is the case on oil burners, they are a necessity, their advantages on coal burners are obvious in features of manufacturing, application and maintenance. On account of these advantages it is believed that it will become more general practice to increase the number of rows of these taper head radials, leaving a few rows at the sides and upper corners of the fireboxes for plain radial straight threaded bolts, similar to the side stays except as to length.

As staybolts are made of a relatively expensive material, all reductions of weight possible, aside from necessary weight to fulfill stress requirements should have earnest consideration. One of the incidental advantages of the taper radial is a saving by omission of the button.

For some reason locomotive radial stays have been generally heavier than seems necessary, considering the fact that their spacing is generally about the same as that of water space stays and the I. C. C. Rules groups all stays for firebox and combustion chambers with a common maximum stress requirement, viz: 7500 lbs. per square inch of net cross sectional area. The same figure is used in the rules as compiled by the Boiler Code Committee of the American Society of Mechanical Engineers, and adopted as standard for stationary boilers in general practice, these rules being also adopted by several states and municipalities for boiler inspection and insurance rules.

When in place very few of the threads of a staybolt are in use, the sum of the thicknesses of the sheets stayed generally not exceeding one inch. On account of the tell-tale hole that end must not be much shorter than 1½ in. It would seem therefore, that very long threaded ends are wasteful of material and that these useless threads in the water and steam spaces only tend to catch and retain precipitated sediment and do not facilitate cleaning.

By careful selection of lengths of staybolts in building and repairing, much waste of staybolt material can be saved. True, there is a great variation of lengths required by reason of the taper of water spaces, the slope of crown sheets and wrappers, requiring time and care in making up the bill of lengths and number required, but it does not take many inches to make a pound, and unnecessarily long threaded ends may lead to leaning on that fact and trimming off and wasting more than necessary.

For convenience in ordering and care of storehouse stock, it has become quite a practice to carry staybolts in inch lengths, and if care is used in ordering, the amount wasted beside the square when ends are clipped or burned off before heading over, need not exceed an average of about ¾ in. per bolt, some more and some less. A survey of the scrap often discloses directions in which economies can be made and waste guarded against.

For maximum staybolt material saving it is believed that 13/16 in. for body diameters between the threaded ends of all staybolts 1 in. thread diameter and over will fulfill I. C. C. Boiler Rules, forging variations, spacings and pressures as found in the average and usual locomotive practice. ¾ in. diameter will allow 207 lbs. steam pressure with 4 in. x 4 in. spacing but 13/16 in. will allow 243 lbs. steam pressure or conversely for 200 lbs. pressure will carry 19.44 sq. inches of area of plate in either case not taking into account the area of one body in the rectangle produced by the spacing.

This review may properly take up the matter of threads. Use of the sharp "V" thread persisted in boiler work for some reason long after its detrimental features had been observed and was set aside in other branches in favor of other types. As applied to staybolts the "V" thread cuts deeper and affords a less cross section at the root than other types and reduces the allowable steam pressure for any given size. The acute bottom angle offers a succession of breaking points at each thread and facilitates breakage as compared with flat or round bottom threads.

The principal builders use Whitworth threads unless otherwise specified, and many of the roads have abandoned the sharp "V" in favor of Whitworth or U. S. Standard threads in their maintenance work. Theoretically the round bottomed Whitworth is the better of the two but practically there is very little difference. Formerly also, there was a tendency to insist on tight fits in staybolt application, which has been modified somewhat. Inasmuch as a straight thread will not make a steam tight fit and as heavy wrenching is very liable to tear the soft iron bolt threads, it has been found that best results are obtained by an easy fit which will not disturb the threads. In driving up a perfect thread on the bolt into perfect threads in the sheets the best results can be obtained.

Furthermore, tap expense in the shop is bound to be very high if the tolerance in tap wear and bolt sizes is very close. As the tightness must be obtained by driving up, a reasonable tolerance can be allowed that will work to tap and bolt economies together with proper application and service.

The question of pitch of staybolt threads is one that unduly worries some people as they visualize theoretical perfection in staybolt taps, holes and bolts. Taps may be machined in pitch but do not necessarily stay so after the ordeal of the tempering furnace. The holes in two sheets, anywhere from 4 in. to 40 in. apart may or may not be in pitch after being threaded with the aforesaid tap, and even if accidentally in pitch immediately after tapping, the other work on the boiler, crane lifting, shop temperature changes, all tend to mar the accuracy deemed so desirable.

It is rather difficult to obtain full production of staybolts, all in pitch with the facilities provided in many railroad shops, but the bolts go in all the same and make a good job and a practical boiler maker of large experience has learned that absolute pitch of staybolts is not an essential factor because he cannot guarantee his taps or tappings, so why worry! In saying all this am not discrediting the staybolt that is in pitch nor the man who tried to fulfill all three requirements aforesaid, but it is a fact that has been proven time and again that there is sufficient flexibility in locomotive sheets that are stayed to permit pitch variation from any of the above three factors, yet allow first class results in application.

If any one who fusses a lot with a pitch guage over a pile of staybolts will spend equal time in going over a lot of holes ready for bolts, he will realize the force of the suggestion. In proof of this a well known Engineer and Expert in machine design some time ago reported having made and thoroughly tested out an indicator, the stem of which passed through two sheets and was held away from one of them by spring pressure. This indicator showed that the boiler plate constantly moved while the bolt was being inserted or withdrawn from the first sheet and even after the bolt adjacent to the indicator was screwed home the plate moved as much as 5/1000 in. when the next bolt was inserted, and so on a lesser amount, showing the movement of the plate for as many as six bolts away from the indicator.

The indicator showed no movement whatever of the plate after it made its first jump when the staybolt had entered the second sheet. From this point on the plate stood practically still when a truly threaded staybolt was used. In one particular case noted there was a plate movement of 5/1000-in., with a poor bolt, apparently not truly cylindrical and for that reason not a good fit.

A further test with a long pitch guage showed holes through two boiler sheets out one-half the pitch of the thread. There seemed to be quite as many in this condition when a continuous tap was used as when a short tap was used, one reason being that the boiler plate moved more than half the pitch by simply putting a strain on the boiler with a crane. In making one test, one particular hole was selected which was as nearly as possible half a thread out of pitch. The staybolt was inserted in this hole and screwed home with the indicator set in the next space, the contact point being as close to the entering bolt as possible. This showed a movement of exactly 41/1000 in. which is approximately half a pitch of a 12-thread. This bolt was screwed out and in a number of times without changing the condition of the boiler otherwise and the movement was practically the same each time.

The most difficult application is probably that of combustion chamber stays, tying two semi-circular surfaces. No staybolt has been found that will answer perfectly to the requirement of 100% service in this location. Combustion chambers are found only as a rule in large boilers, are a great distance from the back head, and the accumulated travel and vibration are very difficult to accommodate, tying such rigid sheets as are here used.

The Railway press and others are agitating the question to what extent a railroad is justified in manufacturing their material. Following is quoted from the August 20th issue of the Railway Age:

> "It is apparently the belief or has been under former conditions that it pays a road to manufacture more or less of its repair and maintenance materials, a few having gone to the extent of including locomotives and cars. Here again comes in the acid test of shop costs, which owing to labor markets, location relative to ma-

terial markets, size of road, quantity of production facilities, all having a bearing and prevent the formation of a general rule which will cover.

"There is no question of the necessity of manufacturing activity to get railroad equipment into shape if we are to have general trade improvement and movement and whether the manufacturing for the roads is to be done by the roads or by manufacturers, must be worked out on the basis determined as desirable policy. The spirit and co-operation of railroad supply manufacturers is well known. Being generally specialists, their facilities and costs are more accurately determined than is possible on a railroad, and are reflected in their prices, which, if measured against the railroad costs, accurately computed, would place the business where it belongs."

To what extent this may apply to the staybolt situation depends on the results of that favored expression of writers on economic matters, "the acid test of shop costs, accurately computed", compared with the merits and prices of manufactured articles. All costs having a bearing on expense of transportation are now under very close scrutiny, owing to the publicity of the general freight rate situation, which, in the opinion of many people needs reduction.

The figures are now available showing the result of high level of freight rates for a year or more, showing that the total net operating income was the smallest they had earned in any fiscal year for twenty years, excluding the guarantee when under government control, and less than half the net earnings contemplated by the Transportation Act. It is difficult to see therefore, how freight rates can be reduced and the railroads net raised as to yield a six per cent. return unless costs of operations in all directions are radically reduced to line up with production in other lines of manufacture and of commodities.

All this, however, is aside from the question, as this review is intended to cover the engineering principles and mechanical developments to date as regards our knowledge of locomotive staybolts, based on experience gained, rather than about freight rates and economic theories and trust you will pardon the digression from the subject in hand in view of what has been so constantly in all our minds during the past few years.

PRESIDENT: Gentlemen, I believe you all agree with me, particularly the locomotive men that Mr. Seley has presented a very interesting subject. The paper is now before you for discussion. We would like to hear from Mr. C. E. Lester, Superintendent of the Boiler Department of the H. K. Porter Locomotive Works.

MR. C. E. LESTER: The type of staybolt advocated by Mr. Seley is a rigid staybolt with a center section reduced by forging. In view of the fact that this particular type of rigid bolt is of comparatively recent origin, it seems but good policy to defer judgment on it until it has demonstrated its utility. It is, however, a well-known fact that heretofore no rigid staybolt of any description has withstood severe breakage in the so-called breaking zone of locomotive boilers. If the type of bolt under discussion will do this it will be required to do more than any other rigid bolt has done.

PRESIDENT: Could we have some remarks from Mr. John L. Smith, Superintendent Motive Power of the Shawmut Railroad?

MR. JOHN L. SMITH: The staybolt question is one which has been given considerable consideration for many years. After vast experience with various designs, we find that we have less trouble account of breakage and that the most satisfactory results are obtained through use of the American Flexible Staybolt.

MR. C. A. SELEY: If I may be pardoned for breaking in at this time I would like to make a statement. Mr. Lester said that I advocated a certain type of staybolt. I did not say that, if I may be pardoned for making that rather abrupt statement. There are special types of staybolts aside from rigid staybolts, as covered in this paper, which are obviously not subject to discussion on the floor of this meeting, being proprietary patented articles of mine and of other makers, which I do not propose to discuss upon their merits one way or the other.

What this paper contemplates is a discussion of the breakage of rigid bolts and of radial stays as we have been making them for many years on many roads, my own former bad practice included; criticizing the use and suggesting the remedy, which is not necessarily a matter of my product but can be practiced in any railroad shop in the country on the lines stated in the paper. It is an open subject in large measure and there are different ways of handling it. I hope that it will open up discussion and that the gentlemen will not be afraid to say what they mean.

PRESIDENT LYNN: I am going to ask Mr. D. F. Crawford to say something.

MR. D. F. CRAWFORD: I do not know whether I ought to talk about staybolts or not. It is over five years since I have had much to do with staybolts. However, the subject of staybolts, and particularly staybolt breakage, is an old friend of mine and I imagine the same kind of a friend that a majority of the men in this room regard it. Mr. Seley's paper has been very interesting to me in recalling some of my own experiences and some of the literature I have attempted to follow on the subject. I notice he stated that the Navy is averse to using rigid staybolts. The first book I ever had the opportunity to read on staybolts was a work issued by the Navy Department. I do not know how old it was when I got hold of it. I always remember that they made a ring and put two sheets on the sides with rivets and put in staybolts of various kinds of material and with various spacings and in various systems and alternately turned on and off steam, producing vibration. I imagine that report was made in 1860 or 1870. They evidently have not changed their mind very much about staybolts since that time.

The subject of breakage of staybolts of course goes back to the rigid staybolt and, as some gentlemen have already spoken of it, the breakage zone. There have always been places in locomotive boilers where staybolts break more frequently than in other locations. The earlier attempts to obviate this breakage, as staybolts grew larger due to more frequent renewal, and the stiffness Mr. Seley spoke of became apparent. Attempts were made by various forms of flexible staybolts to retain the smaller dimensions.

I remember one form that I found on investigation was first put in use in 1875. I was not concerned in putting it in use that early but it answered the purpose so well that a number of them were located after that time in the so-called breaking zone on many locomotives, materially reducing the time engines were held out of service for staybolt repairs. Later the staybolts were developed in a number of directions, some by the railroads themselves, others as patented or proprietary articles, as Mr. Seley has said, all of them giving much better service than the ordinary staybolt when located in the breakage zone. This was also done with the copper staybolts used in some engines. The idea suggested by Mr. Seley seems to me to be a very attractive one, first that the staybolt should be proportioned to the stresses, and care should be taken not to needlessly enlarge a staybolt due to frequent renewals. I remember some attempts to restrict the increase in diameter by whenever a staybolt is broken with sufficient frequency, to enlarge the hole ⅛ in. applying a flexible staybolt. I agree with Mr. Seley as to the difficulties encountered in putting in staybolts. While accuracy is desirable, practical considerations cannot be overlooked.

PRESIDENT: Mr. J. Rogers Flannery, President of the Flannery Bolt Company, may we hear from you?

MR. J. ROGERS FLANNERY: I do not know that I have much to say. As Mr. Seley says: The discussion is really on rigid staybolts, and is not "A review of the staybolt art," as stated in title in advance notices. This paper reminds me of a lecture delivered by Mr. B. E. D. Stafford, General Manager of the Flannery Bolt Company, who gave a talk on locomotive boiler space stays about fifteen years ago, and he gave the history of locomotive boiler water space stays from the time steam engines were first built until 1905. It does seem to me that if you are discussing a review of the staybolt art it would be wise to mention the fact that the railroads have corrected the majority of their troubles in staybolts since Mr. Stafford delivered his lecture in 1905 by substituting the flexible bolt for thhe rigid bolt, wherever breakage occurs. As a matter of fact, I suppose there is not a large railroad in the United States today that does not use flexible staybolts. Reduction of centers is one way of correcting the trouble in rigid bolts but why not correct it entirely? I have not the practical knowledge that most of you have, but from my experience in the manufacture of staybolts and a general observation of staybolt practices and problems in the last sixteen years, I think the remedy for breakage is not in trying to correct the design of the rigid bolt but in trying to secure some new method of staying that will reduce the stresses and strains to which the ordinary rigid bolt is subjected in trying to take care of the expansion and contraction of the sheet. Transverse stresses and strains are breaking your staybolts and no rigid bolt can withstand them. I think reduced centers are a very good thing and have adopted the reduced center in the flexible bolts that we manufacture, because while we think that the strain is minimized by the flexible bolt we naturally wish to take advantage of every bit of elasticity that we can get from the bolt proper. Twenty years ago they were using reduced centers with great success but as locomotives got larger the breakage became greater and today the majority of railroads are overcoming this trouble by the use of flexible bolts.

MR. HENRY F. GILG: My boiler shop practice was limited to three weeks in a locomotive works about forty-five years ago. However, I come in contact every day with people who have their staybolt troubles and I find that in a majority of the cases, when I can learn what material they are using, the principal trouble is with the material, assuming that the boiler is of the proper design. I had a specification for staybolt iron submitted to me recently that could be met by common bar iron made by any mill in the United States. It was no more suitable for staybolt iron than for anything else.

One of the difficulties I have found in many of the brands of staybolt iron is the fact that they are not uniform in quality. There are manufacturers who produce uniform grades of iron of the best quality and I am not speaking of mine exclusively. One of my friends in the room tonight is representing one of the very best irons in the United States. I was told within the past two weeks by a man that he could not imagine why the vibration test differed so much in iron from the same mill. It is the easiest thing in the world. The iron simply is not uniform. If the iron is made from the same kind of pig iron and is manufactured in the same way all the time, it will always give the same results. You cannot get away from that. This point is disputed by many people but they could not change my mind because I know how iron is made.

Now there is one of our competitors who made complete installations on two locomotives in two bad water districts on one railroad system and at the end of two years there had been but one breakage of a staybolt in those two boilers. That is a very good performance and it could be done with only good material. I have been making some inquiries, which may not be altogether pertinent to the subject. Mr. Seley mentioned about the tell-tale holes, etc. I have been told within the past couple of weeks by four men representing four big railroad systems that they have found that there is constant carelessness in testing staybolts with tell-tale holes, that the men depended too much on signs of leakage. I have been told by these men that they did not think the tell-tale holes amounted to anything anyway. The drilled bolts seem to go more largely in the middle west than elsewhere but not to any very great extent.

Now I have found in one case of an iron widely sold that the reason the users were quitting it was that it was not as good as it had been and they did not know why. The reason was, and is, that the iron contained from .13% to .18% copper. You can use pig iron with copper if you want to but it will not give the very best of results for staybolt purposes because it will check and it will not weld as good as an iron free from copper. There are four or five good irons in the country and people buying those irons have very little complaint. Those who are using other brands are having lots of trouble. I have in mind two mills that are putting out staybolt iron made wholly from scrap and anyone who knows anything about scrap knows that it cannot be uniform. I was connected with the first scrap mill in the United States forty years ago and I know what it means.

MR. KARL BERG: Might I ask a question in regards to replacing button headed long crown stays with straight radial stays having reduced centers and tapered heads? The question is, will a straight stay offer as much protection to the crown sheet as a button head stay in case of overheating or low water? The theory has been advanced that when the crown sheet becomes heated and tends to buckle down between the stays, the button head will offer a better support than the straight stay with tapered head. The straight stay will also more readily permit the sheet to open up around the stay on the inner side of the boiler and thus expose the threads to corrosion. As said before, this has not, to my knowledge, been demonstrated in practice but is simply a theory advanced by someone as a possible result.

MR. C. A. SELEY: That came from the necessity of holding up the crown sheets in oil burners where they have extremely high firebox temperatures, greater than in coal burners. These are so extreme that they have to scarf the edges of the sheets and reduce rivet and staybolt heads so as to keep as much of the metal out of the firebox as possible. The tapered head bolt was developed in that service and has proven so successful that its use has been extended to a number of roads with coal burning equipment because of its manifect advantage in application and maintenance. So far as holding up the sheet in low water is concerned, the Master Boiler Maker's Association, in a report printed this year, detailed a large number of tests in pulling this type of bolt in cold sheets and in hot sheets and the results of these tests, also showing the practical results on roads using these bolts. The Master Boiler Maker's Committee recommended the taper head radial staybolt instead of the button head, as doing away with a large amount of maintenance expense.

MR. A. E. ANDERSON: For the benefit of the non-technical members it might be well enough to have a definition of the breaking zone.

MR. C. A. SELEY: The breaking zone is very difficult to define. The term itself means the zone of staybolts which are more particularly subject to breakage than in other localities. Other zones are breaking zones in a more limited degree. It depends entirely on dimensions and design of the boiler. In general, breaking zones cover the portions of the boiler sheets where the progressive travel accumulates and gives a greater vibratory movement than to the bolts located in the center of activity where the lateral stresses are not so great.

If you take the staybolts in the upper and outer edges of the firebox side sheets; the outer edges of the backhead; most if not all of the throat sheet of the boiler, these are considered as having the greatest angular movement and requiring the greatest care in the selection of the type and character of staybolts to be used.

Mr. Flannery says he has a staybolt which is better than the staybolt mentioned in the paper. So have I, but I did not consider it necessary to advertise my staybolt in making these remarks. There is quite a field for improvement in the ordinary staybolts that remain still in engines which do not have a full installation of the special types, and I do not believe that the practice of full installations of special bolts has or will be continued in the same degree as it was some time ago. It may or may not. Times are so troubled and we have all had such a cessation of business that how it will be when they commence to do business again, I don't know. I would be glad if they would make them all special bolts. I am pretty sure that a lot of engines now in the country which have rigid staybolts are not quite as good as they might be if they had followed the lines indicated in the paper.

My only reason in appearing before the Club is to give information as I see it as an Engineer and not as a manufacturer. Reasons have been stated in the paper for various ways of improvement of the bolts which generally obtain and which the railroad man often manufactures. We have the interests of the railroads at heart and honestly question their policy of manufacturing as generally done, and for reasons and recommendations as stated in the paper.

PRESIDENT: I am going to call upon a member of this Club who may not have had very much practical experience in boiler making but he is pretty well informed upon almost any subject connected with railroading—Mr. A. Stucki.

MR. A. STUCKI: It is just about twenty-seven years since the road I was connected with built a special automatic machine to cut up and finish staybolts from rods twenty or thirty feet long without any additional manual labor after a rod was started. These staybolts were cut smaller in the center with a gradual fillet leading to the full size diameter of the threads. This bolt gave good results and I thought it would answer all purposes as it was intended to be sufficiently flexible to avoid breaks on the inner surface of the outside sheets and outer surface of the inner sheets. That this principle is beneficial is again proven by Mr. Flannery's remarks, saying that they now also reduce the central portion of their flexible staybolts. I certainly watched the performance of that machine very closely at that time. It was a true labor-saving device but of late I have had nothing directly to do with staying a locomotive boiler.

MR. F. H. BABCOCK: With no attempt to discuss the paper, I might say a word with reference to my own personal experience. About 25 years ago, and full of pep, I was considered a crack staybolt man insofar as the installation of bolts was concerned and I want to bear out the speaker's statement when he said that by enlarging the bolt you do not increase the efficiency of that bolt.

Before we had modern machinery such as the pneumatic drill, hammer, cutters, etc. to install staybolts, we of course, did all that work by hand and it was hard work too.

In many instances, I have seen workmen who would enter small bolts into the sheets in order to avoid a lot of hard pulling on wrenches which resulted in a loose bolt being increased in size by the hammering and practically depreciating the value of the bolt even before the boiler went into service. Of course, in those days, workmen were not followed up by inspection as they are today and such things are not now permitted.

There are two things we must admit are the important factors in the installation of staybolts. In the first place, you have got to have first-class material and also you have got to have first-class workmanship. Modern machinery has made this work easy as compared with the old day method, and this followed up with inspection insures first-class work. The flexible staybolts may be regarded as one of the great inventions of the day because it is a real SAFETY device.

MR. A. E. ANDERSON: I would like to ask if these drilled holes weaken the end of the bolt to cause it to break.

MR. C. A. SELEY: The tell-tale hole is drilled so small that it does not make any difference; 3/16 in. is the diameter of the hole called for by the law and it does not weaken the bolt.

While on my feet I would like to say to Mr. Stucki that we all now more fully appreciate the character of the stresses and strains to which many details of boilers, engines and machinery are subjected than formerly.

The manner of breakage of ordinary staybolts carries its own suggestion as to character of correction necessary in the design. The boiler sheet relative movement is such as to induce an S curve in the staybolts which would not be properly met by tapering the staybolt body reduction toward the center. A car axle is correctly designed that way to meet the load stresses involved in that service but a staybolt is not loaded that way and should have the body uniformly reduced, in order to receive and distribute lateral stresses.

PRESIDENT: Is there any further discussion?

MR. D. F. CRAWFORD: Mr. Seley has presented a very interesting paper on a very interesting subject, one that would afford much discussion. And yet staybolt practice seems to be so well established, and the principles he has enunciated so clearly, that the paper will be of great value to us. I therefore would move a rising vote of thanks to Mr. Seley for his courtesy in coming here and giving us this very excellent paper.

The motion was duly seconded and carried by a unanimous rising vote of thanks.

There being no further business, upon motion the meeting adjourned.

J. D. CONWAY,
Secretary.

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F. V. McDonnell,
Died April 26th, 1921.

C. S. Prosser,
Died October 26th, 1921.

J. B. Rider,
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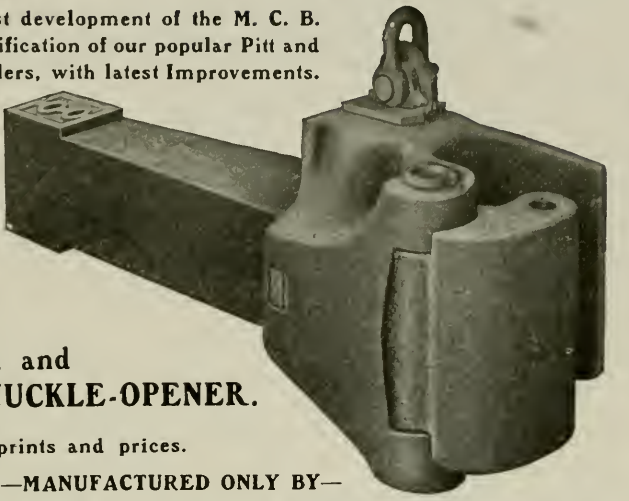

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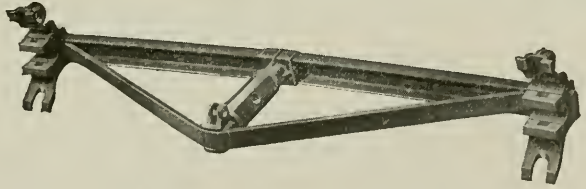

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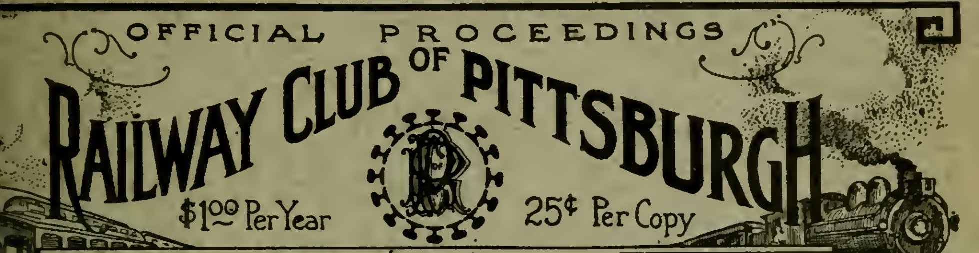

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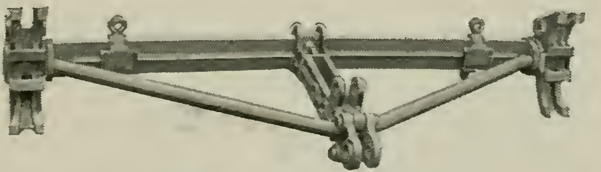

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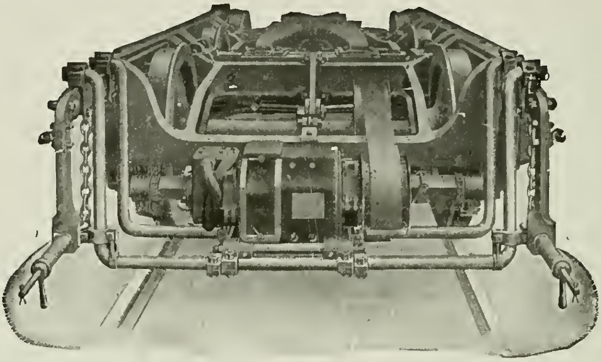

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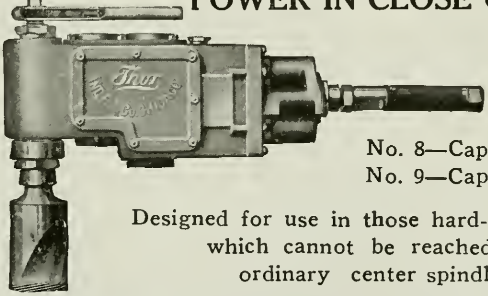

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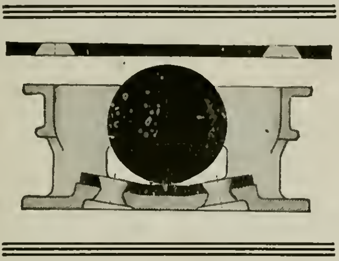

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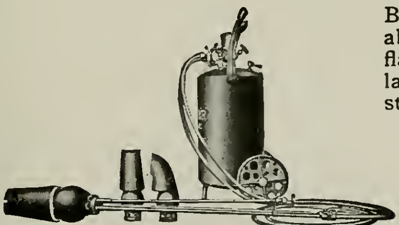

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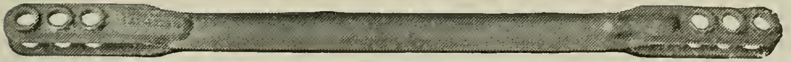

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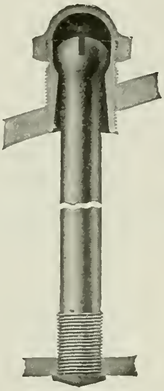

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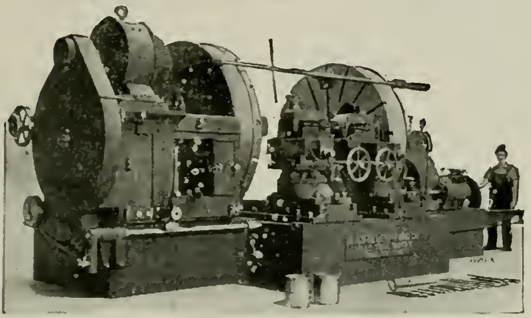

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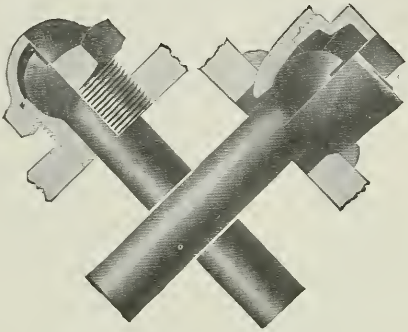

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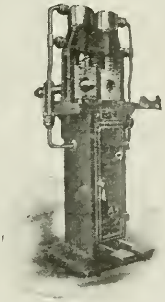

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OF
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Pittsburgh, Pa., Dec. 22, 1921

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Past Presidents

J. H. McCONNELL	October, 1901,	to October, 1903
L. H. TURNER	November, 1903,	to October, 1905
F. H. STARK	November, 1905,	to October, 1907
*H. W. WATTS	November, 1907,	to April, 1908
D. J. REDDING	November, 1908,	to October, 1910
F. R. McFEATTERS	November, 1910,	to October, 1912
A. G. MITCHELL	November, 1912,	to October, 1914
F. M. McNULTY	November, 1914,	to October, 1916
J. G. CODE	November, 1916,	to October, 1917
D. M. HOWE	November, 1917,	to October, 1918
J. A. SPIELMANN	November, 1918,	to October, 1919
H. H. MAXFIELD	November, 1919,	to October, 1920
F. J. LANAHAN	November, 1920,	to October, 1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
DECEMBER 22, 1921.

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock p. m., President Samuel Lynn in the chair:

The following gentlemen registered:

MEMBERS

Adams, Lewis
Allan, W. J.
Anderson, A. E.
Anderson, J. W.
Babcock, F. H.
Berg, Karl
Berghane, A. L.
Bernoulli, W. H.
Brower, J. E.
Carpenter, H. D.
Christy, F. X.
Conway, J. D.
Cotton, C. S.
Cunningham, H. L.
Cunningham, R. I
Donovan, J. J.
Forbes, T. E.
Forrest, C. H.
Fowler, W. E., Jr.
Freshwater, F. H.
Frey, A. R.
Fults, J. H.
Gibson, G. A.
Gilg, Henry F.
Grieve, Robert E.
Gross, Chas.
Hale, Chas. E.
Harger, M. L.
Harney, E. L.
Harris, J. P.
Harsh, H. H.
Hazlett, H. H.
Hindman, S. M.
Hostettler, L. W.
Howe, C. A.
Howe, D. M.
Johnson, A. B.
Jones, Earnest A.
Jungbluth, A.
Kegel, R. C.
Kelley, H. D.
Kelly, H. B.
Kempf, G. P.
King, J. W., Jr.
Knox, Wm. J.
Kranse, H. A.
Kummer, Jos. H.
Lake, Albert H.
Lanahan, J. S.
Lobez, P. L.
Long, R. M.
Ludgate, B. A.
Lynn, Samuel
Matchett, H. K.
Meyers, John M.
Millar, C. W.
Moyer, Oscar G. A.
McAninch, D. A.
McGregor, D. C.
Nelson, W. O.
Olsson, N. A.
Orchard, Chas.
Painter, Joseph
Pehrson, A. K.
Pennington, F. W.
Perry, G. M.
Price, W. F.
Proft, J. W.
Read, S. C.
Richardson, H. R.
Rick, R. C.
Ryan, D. W.
Saltic, Thos.
Sattley, E. C.

Searles, E. J.
Sewell, H. B.
Sheridan, T. F.
Stackman, Albert
Stamets, Wm. K.
Stark, F. H.
Straub, W. C.
Strople, G. H.
Stucki, A.
Summerfield, D. W.
Thorne, H. S.
Thurlby, A. R.
Weissert, W. J.
Wilson, W. J.
Wright, John B.
Wyke, J. W.
Zilian, R. F.

VISITORS

Barber, C. H.
Boss, R. E.
Boyd, O. G.
Boyle, B. C.
Calvin, O. J.
Campbell, N. K.
Carbis, N. J.
Cochrane, C. T.
Cunningham, W. N.
Donahoe, T. F.
Duckworth, W.
Foard, M. W.
Fox, M. P.
Gudge, B. J.
Hanna, C. E.
Hoerner, A. S.
Jones, D. E.
Koenig, C. A.
Lalley, P. J.
Madden, L. P.
Mahan, W. C.
Meckert, F. A.
Morrison, J. M. J.
McPhee, R. W.
Newburn, T. W.
Nicholls, P.
Obel, W. M.
Rankin, H. P.
Smith, Sion B.
Swansson, F. M.
Trueblood, H. J.
Willison, I. E.
Wills, R. B.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Baer, Harry L., President, Sterling Equipment & Supply Co., 703 Empire Bldg., Pittsburgh, Pa. Recommended by Wm. H. Ritts.

Burns, Thomas F., Fore. Car Insp'rs., Penna. System, 600 Church St., Gallitzin, Pa. Recommended by J. F. Courson.

Burton, G. H., Asst. M. M., Penna. System, Conemaugh, Pa. Recommended by C. B. Gray.

Carbis, N. J., Gen. B. F., B. & O. R. R., 808 Unity St., Homestead, Pa. Recommended by T. E. Forbes.

Dalzell, Joseph, Fore. Car Insp'rs., Penna. System, 7014 Kelly St., E. E., Pittsburgh, Pa. Recommended by J. F. Courson.

Dorfeld, F. C., Passenger Clerk, Penna. System, 214 Virginia Ave., Aspinwall, Pa. Recommended by T. M. Blakley.

Elsey, Warren R., M. P. Insp'r., Penna. System, 204 Penna. Station, Pittsburgh, Pa. Recommended by C. G. Skuce.

Emerick, Jesse C., Production Checker, Penna. System, 534 Gross St., Pittsburgh, Pa. Recommended by C. B. Gray.

Fair, Charles, Fore. Car Repairs, Penna. System, 43rd St. Shop, Pittsburgh, Pa. Recommended by S. C. Read.

Galinis, J. W., Draftsman, Penna. System, 311 Westinghouse Ave., Wilmerding, Pa. Recommended by J. L. Cunningham.

Graham, John A., Steam Engr., 522 Knoll St., N. S., Pittsburgh, Pa. Recommended by W. H. Ritts.

Gray, C. B., M. M., Penna. System, 1155 Liberty Ave., Pittsburgh, Pa. Recommended by J. L. Cunningham.

Haas, John G., Asst. E. H. Fore., Penna. System, 430 Fisk St., Pittsburgh, Pa. Recommended by J. E. Brower.

Heigley, R. M., Asst. R. F. of E., Penna. System, Braeburn, Pa. Recommended by T. M. Blakley.

Leach, C. C., Fore. Car Insp'rs., Penna. System, 408 Grant St., South Fork, Pa. Recommended by J. F. Courson.

Marton, Richard A., Asst. E. H. Fore., Penna. System, 4080 Cabinet St., Pittsburgh, Pa. Recommended by J. E. Brower.

Morse, J. W., Asst. R. F. of E., Penna. System, Freeport, Pa. Recommended by T. M. Blakley.

Murray, M. Y., C. C. to R. F. of E., Penna. System, 525 Penn St., Verona, Pa. Recommended by T. M. Blakley.

McBroom, J. F., Fore. Car Insp'rs., Penna. System, 216 W.

Fifth Ave., Derry, Pa. Recommended by J. L. Cunningham.

McCully, B. N., Fore. Car Repairs, Penna. System, East Pittsburgh, Pa. Recommended by J. L. Cunningham.

McKinley, Andrew, Asst. Fore. Mach. Shop, Penna. System, 546 North Ave., Verona, Pa. Recommended by S. C. Read.

North, D. P., Fore. Car Insp'rs., Penna. System, 1173 Milfred St., Johnstown, Pa. Recommended by J. F. Courson.

O'Leary, Jeremiah J., Gang Fore., Penna. System, 132 Fourth St., Oakmont, Pa. Recommended by S. C. Read.

Pfarr, Jacob, Foreman, Penna. System, 7317 Hamilton Ave., Pittsburgh, Pa. Recommended by C. B. Gray.

Quinn, John M., Work Distributor, Penna. System, 1242 Illinois Ave., Dormont, Pittsburgh, Pa. Recommended by J. E. Brower.

Russell, Ralph P., Asst. Supt., Penna. System, P. O. Box 24, Cresson, Pa. Recommended by W. L. Hudson.

Smith, Clay C., Foreman, Penna. System, 336 Second St., Pitcairn, Pa. Recommended by J. F. Courson.

Spotts, Arthur, Asst. Fore., Penna. System, 1201 California Ave., Pittsburgh, Pa. Recommended by C. B. Gray.

Tarr, Charles F., Machinist, Penna. System, Verona Shop, Verona, Pa. Recommended by S. C. Read.

Tarr, George B., Foreman, Penna. System, 615 South Ave., Verona, Pa. Recommended by S. C. Read.

Tracey, J. B. A., Div. Accountant, Penna. System, 1003 Penn Ave., Pittsburgh, Pa. Recommended by T. M. Blakley.

Trueblood, H. J., Salesman, Chicago Pneumatic Tool Co., 10 Wood St., Pittsburgh, Pa. Recommended by W. C. Straub.

PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

Announcement was made of the death of Mr. B. E. D.

Stafford, Vice President and General Manager, Flannery Bolt Company, died November 30, 1921.

PRESIDENT: Appropriate memorial will appear in the Official Proceedings of the Club.

There being no further business, Mr. H. P. Rankin, Manager Pittsburgh Branch, Johns-Manville Incorporated, presented the paper of the evening, illustrated by moving pictures, upon the subject:

"MINING, MANUFACTURE AND USES OF ASBESTOS"

By H. P. Rankin

The name ASBESTOS is that given by mineralogists to one of the most remarkable substances found in nature and was derived from the Greek form signifying Unconsumable.

It is a peculiar species of the Horneblende family of minerals, and chemically speaking, is a Silicate of Magnesia, being composed of Silica, Magnesia, Alumina and Ferrous Oxide and consequently unconsumable, hence its name.

Paradoxically, it is the link which completes the chain between the vegetable and mineral kingdoms, and it in fact a mineralogical vegetable, possessing the curious properties found in both, for it is at once fibrous and chrystaline, elastic and brittle, heavy as a rock in its crude state, yet as light as thistle or eiderdown when treated mechancially. Added to this, its fibres, soft, white and delicate, have by their inherent quality of indestructibility, defied the action of the elements since the world began and through all the countless ages, during which the hardest rocks surrounding it have been reduced, this mineralogical mystery has remained intact, having successfully resisted the assaults of fire, acids and time.

To examine a quantity of this fibre, one would think that it would blaze up at the touch of a lighted match, or be dissolved immediately when brought into contact with acids, yet it resists extremely high temperatures and is practically unaffected by the severest laboratory tests.

It looks delicate, yet it can be carded, spun and woven into very strong yarn just as easily as wool, flax or silk. Although the rock itself is heavy, yet the fibres can be woven into cloth weighing less than 16 oz. to the square yard.

Of these interesting properties, perhaps the most valuable is its indestructibility, which enables it to resist decay and destruction under almost every condition of heat and moisture. Compared with other materials, this property possessed by Asbestos is unparalleled. Wood burns—Asbestos is unchanged by flame or temperatures to 1500 deg. F. Stone disintegrates—Asbestos defies the elements. Steel rusts—Asbestos is immune to climatic or atmospheric conditions.

While many theories have been advanced to account for the formation of Asbestos, geologists in general concur in believing that its origin is volcanic, and took place during the prehistoric cooling of the earth's surface and that either water or steam are responsible for the breaking apart of the original rock formation and its rebuilding under pressure into its present fibrous state.

Asbestos as found in nature, is classified in three divisions, namely:

1. Antophyllite—which is not used commercially;
2. Amphibole, or Horneblende Asbestos. This includes several varieties, among which are Actinolite and Italian Asbestos.
3. Serpentine Asbestos, which has three forms—Pierolite—Soapstone or Talc and Chrysolite.

Crysolite Asbestos is composed of silky threads of considerable length which lend themselves to the spinning processes necessary to the manufacture of this mineral into various products, and is the only one which has a great economic or commercial value. A typical analysis of this type is as follows:

Silica	40%
Magnesia	42%
Ferrous Oxide	3%
Alumina	1%
Water	14%
Specific Gravity	2.219

The chemical analysis is important in determining the value of an Asbestos Deposit, because all fibres capable of being spun must analyze about as stated.

The percentage of water has apparently much to do with the strength, silkiness and flexibility of the fibre.

While Asbestos occurs in some form or other in nearly every Country in the world, it differs with the locality, not only in appearance, but also in physical and chemical characteristics. Some few sections of the world yield Asbestos which can be used for a surprisingly large number of purposes, but in most cases, either because of the coarseness of the fibre, or because of imperfection in its texture, it is practically useless commercially.

In no other Country, has the mining of Asbestos, especially its preparation for the market, attained such proportions or success as in Canada. The excellent quality of Canadian Asbestos, the richness and accessibility of the mines, will enable Canada to hold the lead in the produtcion of Asbestos for many years to come.

The most important of other producing countries in point of quantity is Russia, but the Russian Fibre is rather harsh and has a yellow-brownish hue. Further drawbacks in Russia are the remoteness of the mines and the shortness of the mining season, which, on account of the weather, lasts on an average of scarcely two months, and with no mechanical means employed in the Russian mines, the work must be rushed feverishly by hand during the short season, and naturally cannot be done thoroughly or on a large scale.

Italy, the first country in which Asbestos was produced, yields a type of this mineral which is chemically about the same as Canadian Asbestos, but its physical properties are quite different. Good long fibre is seldom found in Italian mines.

Asbestos is also found in the United States, South Africa, Newfoundland, New Zealand, Queensland and Southern Australia, and many other parts of the world, but with few exceptions, for one reason or another, the Asbestos mined in these countries does not adapt itself to commercial use so readily as Canadian Asbestos.

The Ancients living in what we call the "Dark Ages" held Asbestos in awe and the wonderful tales about this mineral grew more wonderful with each telling. It is related that the Great Emporer Charlemagne, who ruled over a large part of Europe in the Ninth Century, had an Asbestos blanket with which he used to astonish his guests by throwing it into the fire and taking it out again unharmed.

Pliny refers to it in his Works and it was undoubtedly used by the Greeks for cremation cloth.

About the year 1250 A. D., Marco Polo, the famous explorer, was making discoveries in many new lands of the Far East. He found that the Tartars and Chinese knew about Asbestos and its fireproof qualities and were in the habit of using it for many purposes. They tried to mystify him by telling him that it was made of the skin of a fabled Salamander (a lizard which it was said was able to live in the midst of fire), but the explorer investigated its true origin and returning from Tartary, he wrote:

> "In the same mountain there is a vein of the material from which Salamander is made. For the real truth is that the Salamander is no beast, as they allege in our part of the world, but is a substance found in the earth."

and he also told how the rock was mined, pounded into wool in great copper mortars and woven into napkins for the Great Kahn.

Thus, for centuries Asbestos remained but a curiosity, a mystic mineral paradox. Today it is recognized a commercial necessity, and has been made so, as is the case with so many other of nature's wonderful resources, by American initiative, brains and ingenuity and thus contributing to the world's progress in making life safer and more complete, as well as performing a most important function in the evolution of the world's great industries by making possible numerous improvements and by aiding to a marked degree in the conservation of heat energies which today is the heart-throb of industry.

Although these various properties of Asbestos were known since the time of the early scientists, it was not until about 1870 that the first experiments were made for using it on a commercial scale. At about this time, the first specimens of a very fine Asbestos from Canada were exhibited in London. In 1878 small quantities were mined in Canada, and a lot of some 50 tons of selected crude Asbestos was shipped to

England, but great difficulty was encountered in selling it, as no regular demand for Asbestos had been established.

The uncertainty of the supply, the slight knowledge of how this mineral could be used, as well as its high price, due to the very crude and slow methods of mining, were responsible for this lack of interest.

However, the excellent quality of Canadian Asbestos and the accessibility of the mines finally attracted sufficient interest to induce some enterprising business men to investigate further. The more these men investigated it, the more apparent became its possibilities, and in a few years busy mining camps soon sprang up around Black Lake and Thetford in the Province of Quebec.

Hand labor, which was then used in mining this rock and preparing it for manufacturing, was naturally slow and clumsy, and, as a result, the cost of Asbestos was very high. As uses for this material began to develop, experiments were started to speed up the mining operations and bring down the cost. Many experimental machines were installed, discarded, and remodeled, before satisfactory results were obtained. The difficulties to be overcome were many, and, as the aim was not only to replace hand labor with machines wherever possible, but also, to separate the Asbestos more thoroughly from the rock in which it was imbedded than had hitherto been possible.

After years of persistent effort, these difficulties were overcome and the present-day efficiency of Asbestos Mining and production was obtained.

In order to bring out some of these difficulties, it might be well to illustrate by stating, that, in order to produce one hundred tons of Fibre of various grades, it is necessary to quarry, blast, hoist, and put through the mill, 2,000 tons of rock. To handle this quantity of rock requires twelve locomotives, five steam shovels, thirty-six miles of track, twenty-two derricks, 300 cars and 3,000 electric Horse Power to operate the mills, all of which would represent an investment of approximately $2,000,000.

While Asbestos has been mined in Canada for something over forty years the development has been slow up to the last ten or fifteen years, until now 85% of the world's production of Asbestos comes from two points, in Canada, both located in the Province of Quebec; one district known as the Thetford and Black Lake District and the other known as the Danville District.

The largest mine in the Danville District is that of Johns-Manville, Inc., which covers about 500 acres. The outcroppings of Asbestos Rock so far developed at this mine cover about 100 acres and the main quarry is 1,500 ft. long, 600 ft. wide and 200 ft. deep. As practically the whole mass of rock has to be mined, the operations are carried on in open pits or quarries. In view of this fact, it will be readily understood what difficulties are encountered during the Winter months. Due to the severe weather conditions, there is very little production during the months of December, January and February.

These mines are operated practically in the same way as stone quarries, the operations being carried on by a series of steps or benches, which enable the miners to dislodge large quantities of rock at each blast. The rock is so hard that it is necessary for it all to be drilled and blasted. Electricity and compressed air are used for operating the drills. The drill holes are usually from 8 ft. to 20 ft. deep. Dynamite is used for the charge, the blasts being set off at noon and evening when the men are leaving the work.

After the blasting, a number of men known as cobbers go into the pits. They examine all the rock that is blasted, and pick out the rock having veins of ½ inch and longer of Asbestos, which they can, in a great many places, very easily dislodge from the rock with small hammers. This material is then taken to a cobbing room where it is further cleaned and sorted into several grades.

The balance of this rock in the pits is either loaded into cars by means of steam shovels, or is hoisted from the deepest parts of the pits in buckets to the surface, and from there conveyed to the mills about a quarter of a mile from the pits. Here the rock is dumped into large bins, and from these bins into enormous crushers, which reduce it to pieces the size of a man's fist. These crushed pieces are then conveyed to rotary dryers in order to dry the rock. From the dryers the rock passes into cylinders which crush (not grind) it into very small particles.

This crushed rock containing the Asbestos Fibres is then taken by conveyors and passed over shaking-screens about 6-ft. wide and 12-ft. long. As the fibre is much lighter than the rock, it comes to the surface when the screens are oscillated, and is lifted from the screens by air suction into large revolving cylinders, known as graders. These graders separate the fibre into four grades; the first two are the long spinning fibre used in the manufacture of various textiles; the next a medium grade which is used for making Asbestos felts for roofing, fire felt sheets for insulating purposes, etc., and the fourth, or short grade is usually used in the manufacture of mill board, cements, etc. The fibre is packed in bags of 100 pounds each and is shipped in this manner.

The next step is the Factory, where the crude Asbestos is worked into shape for the manufacture of numerous materials, and where millions of square feet of floor space are required as well as a large amount of machinery and thousands of employees.

As has been intimated, the value of manufactured Asbestos products is in direct ratio to the length of the fibres used in their making. This does not mean that the products manufactured from the longest fibre constitute the bulk of the Industry, because, on the contrary, the greatest percentage is made from the medium and short fibres.

It might be well to name some of the most important of these materials and in an effort to treat the subject briefly, we will arrange these serially, according to the grades of fibre, beginning with the longest:

The longest and of course the most valuable Fibres are used in the manufacture of yarns and cloths for numerous purposes. In addition to being the most interesting process, the making of yarns and cloths has been the most difficult to develop, because, although in general the methods used are similar to that used with cotton and wool, on account of the fact that Asbestos Fibres lack the microscopic barbs found on wool and other fibres, it has required the bringing together of all the talent of textile manufacturers to overcome this difficulty. On this account, it has required the designing of a large amount of special machinery to produce the splendid product of today.

The crude Asbestos which is used in the manufacture of various textiles is first run through heavy rollers which crush the rock without destroying the fibre. The partially broken up mineral then passes through separating machines which automatically remove every particle of rock from the crushed mass of Asbestos, leaving the fibres clean and ready for the next operation. Other machines then open up or crush it into a fine mass. It is then ready for the dusting machine, which blows the fibre about, automatically taking out all of the fine dust and any remaining short particles of fibre. The resultant product is a long, clean fibre ready for spinning.

The carding machines are the basis of all twisted Asbestos and the starting point of all Cloths and Textiles.

The yarns which come from these machines are woven into cloths of various weights, thicknesses and density, according to the mechanical purposes for which they are intended. They may be plain or Asbestos-Metallic. The former being composed solely of Asbestos, the latter consisting of Asbestos Yarn twisted around strands of fine brass wire, woven into Cloth.

The plain cloth is used for many purposes, the most important of which are rod and valve packings. For this purpose, the cloth is coated, or, as technically called, frictioned with rubber compound and rolled up to the required diameters, round, or calendered square, where such packing is required. These packings are furnished in coil, spiral or round forms, according to the requirements of the engineers, and are thoroughly lubricated and graphited ready for use when supplied to the trade.

The cloth with wire interwoven in the strands of asbestos is frictioned in the same manner, and may be used as flat sheet packing or folded into gaskets for various conditions.

Asbestos is one of the greatest known filters, and is used extensively in all filtering processes, either in the form of fibre or cloth, more specially the latter as in this form it is more convenient. Laboratories and chemical plants use it for filtering acid solutions where organic fabrics would be destroyed. It has also made many wonderful electrolythic proescses possible, where it is used as diaphrams in the cells or compartments.

Asbestos Cloth, plain or wire interwoven, preferably the latter, is universally used as a fire barrier or curtain in the proscenium opening of stages in theatres, and public halls of a similar character.

From this cloth is made gloves, coats, trousers, and leggings for the protection of workmen in furnaces, and glass plants, and for domestic purposes is made into tablecovers, iron holders, etc.

Another important use to which some of the longer fibres is applicable, is in the making of brake linings of all kinds. The unusually high frictional properties of Asbestos together with its immunity from the disintegrating effect of water and oil and its ability to withstand the high temperatures caused by such friction has brought this material into universal use for this purpose. It has made possible, increased efficiency in the handling of automobiles, hoists, cranes and other types of machinery where friction clutches and brakes are used.

The medium length fibres are made, by various processes, into all forms required for the insulation of heated surfaces, such as pipes, boilers, heaters, air ducts, ceilings, flues, stack linings, etc. Among these are included felted insulation, 85% Magnesia and a variety of celular asbestos insulations which are built up from asbestos felt or paper, and the various insulating cements of which there are several grades, each being applied to conditions for which it is most fitted.

Of all these various forms of heat insulation, the most interesting are the Felted and 85% Magnesia Insulation. Although perhaps, these two insulations do not make up the bulk of the various combinations used for insulating purposes, nevertheless, they have been instrumental in bringing about the present day efficiency of superheated steam and have made possible, by the conservation of heat units, the saving of hundreds of thousands of tons of coal annually, in our great industries.

In the felted form of insulation, the fibres are felted together by natural felting processes which, together with the addition of ground sponge and certain other inert materials, produces a felt which can be built up into various thicknesses, rolled into cylindrical half sections for pipes, made into sheets and blocks for larger surfaces and into rolls where a flexible insulation is required and at the same time producing a product unparalleled for strength, durability and efficiency among insulating materials.

The other material, 85% Magnesia, is a well known form of insulation, possessing an initial efficiency almost equal to that of the felted insulation and appears on the market in a moulded form, being composed of 85% of Magnesia Carbonate and 15% Asbestos Fibre. Carbonate of Magnesia is used for the bond in this material because of its lightness and the fact that like sponge, etc. in the combination mentioned above, produces a structure of an infinite number of dead air cells, which is the basic principal of all insulation.

Of the various grades of short fibres, there are also a number of important materials made. Among these are the different Asbestos Papers or Felts. These papers or felts are manufactured in very much the same way as is the case with paper made of wood pulp or other fibres and vary from one hundredth to ⅛ of an inch in thickness. The great number of uses to which Asbestos Paper or Felt is put, are too well known to need reciting, but it may be of interest to state that these felts are the basis of all Asbestos Roofing.

For this purpose, a specially selected grade of short, fibre, free from grit, made up into felts which are saturated with a bituminous material, usually a natural asphalt compounded with non-volatile oils on account of the natural property possessed by such an asphalt of retaining its oils and thereby its flexibility and life for a long period of time. It is claimed for Asbestos Roofing, that on account of the fact that asbestos will not rot, rust or decay, it possesses all of the much desired requirements for a permanent roofing felt and all that it needs to give it an undetermined life is a proper waterproofing element. One other use in this field to which Asbestos Felts have been put is in the protection of steel for roofing or siding on factory buildings of various types.

Certain grades of the shorter fibres of Asbestos, have of recent years, been used very extensively in combination with Portland or hydraulic cements in the manufacture of fireproof lumber, corrugated asbestos roofing and asbestos shingles. The method of manufacturing this type of product, is by the mixing of Asbestos Fibre and Hydraulic cement, pressing the combination into its various forms under enormous hydraulic pressure.

There still remains one other field in which Asbestos materials are widely used and that is in connection with electricity. For this purpose, Asbestos Fibres of various lengths, both long and short, are used in the moulding of pieces of innumerable designs and sizes, where a material with considerable dielectric strength combined with fire resisting qualities is required. Asbestos Paper in the form of ribbon or tape together with Asbestos Yarns and Listings are widely used in the construction of various electrical apparatus and in the covering of electric wires and cables where they are often used in connection with insulating compounds affording a high electric resistance with considerable fireproofing qualities.

It is impossible on account of the limited time to go further into the various products made from Asbestos, but in conclusion, I would like to say that—

The story of Asbestos does not end with the factory or the manufacturing processes it must pass through.

The miner does not see the mighty girder in the ore with which he fills his mine-car. It only counts as "one more load down the chute" with him.

To the worker in the rolling mill, the ingot carries no hint of the finished structure. Plates and angles only mean so many hundredweight of "shapes" tallied up as a good day's work.

The men who build a bridge between two cities look upon it only as a well-constructed fabric of steel girders, faithfully put together. The result their labor will have on the lives of their fellow beings, the human side of the bond between communities which that bridge becomes, rarely occurs to their minds.

And so with all of the various utilities of modern civilization, which we are so accustomed to accept as nothing unusual. Their real effect on our very existence is hardly even given a thought.

We, in the business of producing and manufacturing asbestos, are interested in the strange vegetable-mineral for what it is, how more may be obtained, and what we can make out of it. But the human chapter of the story of asbestos, goes further afield.

Consider what asbestos products do. Not their mere mechanical function, but the countless ways in which they contribute to the daily existence of millions of people; the thousands of plants in which the safety of the workers and the continuance of the efficiency of production depends upon the unfailing, satisfactory performance of a product of asbestos.

The same spirit of service to the community developed a pipe covering which would maintain a difference between inside and outside temperatures of some five hundred odd degrees—a praiseworthy service not only in its mechanical ingenuity but in the conservation of every unit of heat energy to maintain a production at its maximum. Every pound of coal saved, or used to its utmost, contributes directly to the service of the whole United States.

And so we come to the kernel of the story of Asbestos. It is more than an article of commerce—it is a servant of the people—to their comfort, safety and profit.

PRESIDENT: We have had a most delightful trip through the mines and mills of the Johns-Manville Company. Have any of the members questions they would like to ask?

Many questions were asked and answered, among them the following:

(Question)—Is any use made of the waste rock that is brought out with the ore?

(Answer)—The only thing it is used for is filling for factory sites.

(Q)—Is there such a thing as synthetic asbestos?

(A)—Not that I know of. In fact, I am sure there is no such thing.

(Q)—How extensively are Asbestos Shingles used?

(A)—It is surprising how many are used. Take our own branch in Pittsburgh, you would hardly realize that we would sell in this territory 100 carloads of Asbestos Shingles in a year.

(Q)—Are they brittle so they break as easily as slate?

(A)—They break less readily than slate. One of the most advantageous features is that the Shingle is homogeneous, it is the same throughout. With slate it is a most difficult proposition to get a slate that does not have what they call ribbons or soft veins running through the slate strata. If you could get a real mica slate it is a wonderful material and will last years and years. But while at one time you could get mica slate, the production is small and it is very difficult to get and the cost is high. There are two kinds of slate. One is the mica base and the other is the clay base. The clay base slate, some of which is found in this state, especially the eastern part, is soft and the life is not very great. You have often noticed a portion of a slate cracking and falling off. That means that the soft ribbon that ran through that slate has disintegrated and that portion has broken off. Asbestos Shingles are a homogeneous product. You know that within reasonable limits the longer portland cement is exposed, the harder it will become. That, together with the fibre which makes up the Shingle, are two very durable elements. We have not made Shingles for very many years, only about ten years, the life of the shingle is a great many more times that.

(Q)—Itsn't it a fact that we have a slate in Pennsylvania that fifty years is considered the life of it?

(A)—Yes. I said when you get a real mica slate it is a mighty good roofing material. But it is very difficult to obtain today. You seldom find it in the market.

(Q)—Will the asbestos shingle hold its color permanently?

(A)—Yes. The grey color is the natural color of the cement. It is a very difficult matter to make the colored asbestos shingle, due to the fact that it is very difficult to get a coloring material that will hold its color. It is almost a laboratory proposition. You have to put in a very expensive coloring material in order to get one that will not fade. We have never yet been successful in making a green shingle that would hold its color, but we have a red and various browns and a grey that hold their color. The only objection that can be raised is that the asbestos shingle will occasionally bloom, as we call it. You take a wall laid up with cement, after it has been out through a winter you often get a white excrescence from the surface, that is the lime in the cement. The same thing occurs with the asbestos shingle. But when you do have it occur, in 99% of the cases it will disappear of itself if you leave it about a year because the weathering of the shingle will finally bring all of that out and wash it away. As a matter of fact we are always making improvements, and no later than yesterday—something we have been working on for a long time—we have put these shingles through a process that we believe will prevent even the occasional blooming. I do not know just how it is done at the factory, but they are given an acid bath to take out the lime, lime being very readily attacked by some dilute acids. It depends on your state of mind whether this blooming is objectionable or not, where you want something with variegated colors you have it there all right.

(Q)—How do they compare with a coated wood shingle?

(A)—We do not make a veneered shingle, because to be frank about it, it ought to be homogeneous and there should not be anything on the surface to break off or wear off. The idea of course is that the veneer will hold it like a thin varnish, but you would still get your action when the weather gets down to it.

(Q)—How does the cost of the asbestos shingle compare with slate?

(A)—It depends on the type of shingle. Our colored shingle is higher than what you would have to pay for slate but less than ½" tile. Our 16 by 16 shingle is about the price of anything except a very low grade slate. That style of shingle is used to a very large extent on industrial houses. If you were going to build a house for your own use, I would not recommend a 16 by 16 shingle. It is too large to look well. A 12 by 12 of the same style makes a much prettier roof. What you want in an industrial plant is to get the material and you do not care so much about the artistic effect.

We also make a shingle shaped just like slate, rectangular, both ⅛" and ¼" thick. The ¼" thick are all made with rough edges and they give a very rugged appearance to the roof and make a very nice roof. You can get that in anything from a dark red to a very light brown and some greys.

(Q)—What is the salamander insulations used on steel passenger cars?

(A)—This is a material made of hair felt sheeting on the sides and ends and ¼" laminations with Asbestos sheets between on the roof.

It may be interesting to state that of all commercial materials used for insulating, hair felt is the most efficient. It will not however, stand heat over 150 degrees and therefore is not practicable for steam pipe insulation.

It is adaptable as an insulator when subjected to low temperatures, as an example in refrigerator cars and is more efficient than any other material that can be used for this class of work.

As I have stated in the paper, Asbestos is not a good insulator but there is nothing else produced that will lend itself to the manufacture of dead air cells as well, and that is what makes insulation. Hair felt is just full of dead air cells.

(Q)—As to these dead air cells, why do you recommend this Air Cell paper? Those cells are open and the air can travel through?

(A)—In answer to that, I would make an illustration, like other conditions in the industrial world, you can save energy, in this case in the form of heat, up to the point where it pays to go.

In other words, if you applied a covering on a pipe of low pressure and temperature an insulation of a thickness and quality that would produce a maximum of efficiency, that would not be advisable because the saving obtained in dollars and cents would not show as high a return on the investment as would a less efficient and cheaper insulation.

In the case of a pipe carrying high pressures and temperatures of steam, there is a considerable increase in heat losses due to radiation and the money invested in a highly efficient insulation is justified.

(Q)—From your experience in insulation do you concur in the report from the University of Illinois on warm air heating? They have been making a test for three years, and while the test is not completed and will not be for several years, they report that asbestos paper is a detriment instead of a benefit to warm air heating pipes and they recommend an air cell covering. The Carey Company has got out a special paper to take care of this report of Professor Willard. Have you had any experience in that line?

(A)—I think I know what you mean—

Ordinary Asbestos Paper sold to cover tin hot air heating pipes in a house does no good as an insulator. We do not recommend it. People buy it just because it is asbestos. As a matter of fact, a bright tin pipe offers greater heat resistance when a thin layer of Asbestos Paper is applied over the polished surface, and it would be better if the pipe was not covered at all, rather than to paste over it a layer of paper. This however does not apply where you have a pipe insulated with one or more layers of Asbestos Corrugated Paper. There you do have dead air spaces and the more there are the better the insulation.

We have recently brought out an insulation that does not cost any more than ordinary air cell covering which we have named Improved Asbestocel. This insulation is made up of layers of plain and corrugated paper. The corrugations running the length of the pipe are interrupted by a series of corrugations running around the pipe. This has the advantage of breaking up the air spaces as well as increasing their number.

In the old type of Air Cell, the corrugations run but one way, along the length of the pipe and the heat will follow the path through the cell with a tendency of escaping at the joint at the end of the section. This cannot occur when the longitudinal valleys are interrupted about every inch, as in our new insulation. which makes it a very efficient low pressure insulation.

For high pressure work, these forms of insulation are not efficient enough nor will they resist heat sufficiently to warrant their use. In which case you have got to use a covering that is more efficient.

(Q)—Where asbestos wood is subject to heat and cold does that have any effect on cracking. does it give any trouble in that respect?

(A)—On account of the heat insulating qualities of Asbestos Wood, it will not crack when there is a sudden change of temperature. It conducts heat very slowly and for that reason the change cannot be so sudden within the material itself.

Grade "A" Asbestos Wood will stand from 1000-1200 degrees continuously with practically no deterioration. Grade "B" asbestos wood will stand 1200-1400 degrees continuously with practically no deterioration. Either grade will stand much higher temperatures and will not burn, but the deterioration is more rapid depending on the temperature. When subjected to short periods of high heat, the material is not seriously effected.

MR. E. C. SATTLEY: I believe I express the sentiment of all present when I say that we have been exceedingly well entertained and greatly instructed by the splendid paper presented by Mr. Rankin, also by the display of the marvelous pictures. As the subject has been so well presented, I would move a rising vote of thanks be extended Mr. Rankin and his Assistant in recognition of their courtesy.

The motion prevailed by a unanimous rising vote.

There being no further business, upon motion the meeting adjourned.

J. D. CONWAY, Secretary.

In Memoriam

B. E. D. Stafford
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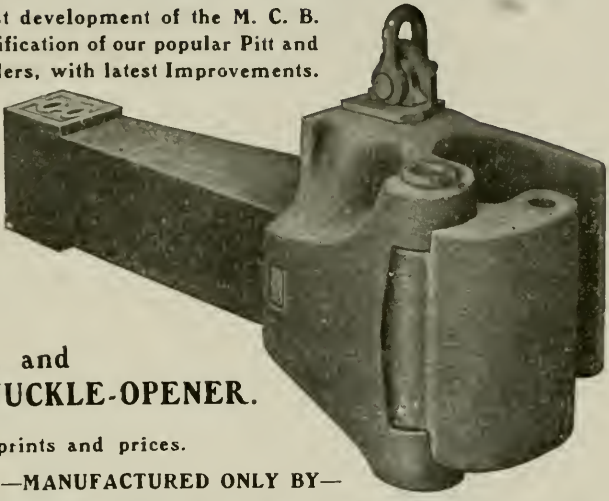

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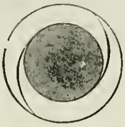

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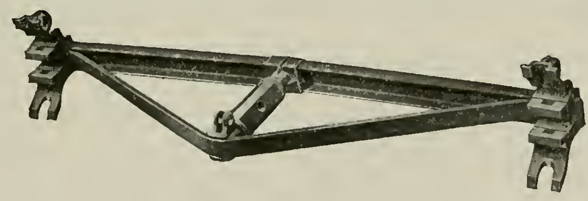

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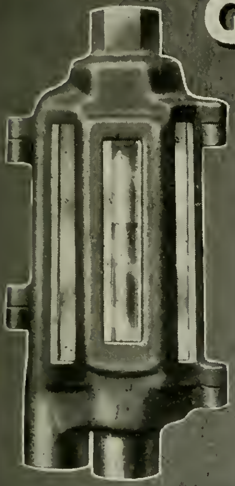

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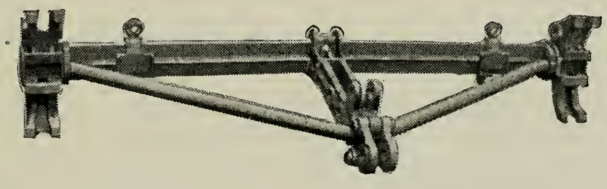

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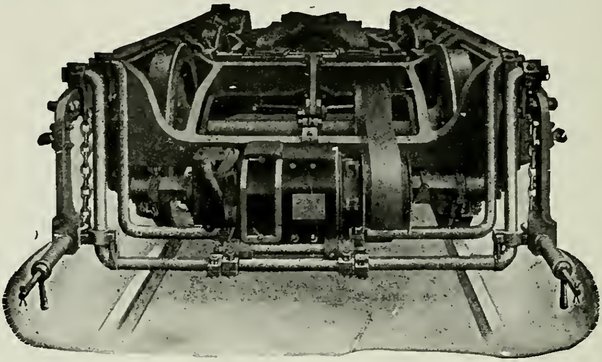

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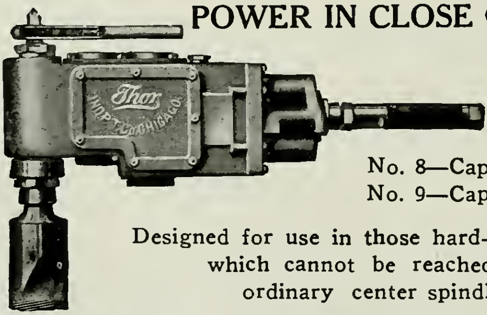

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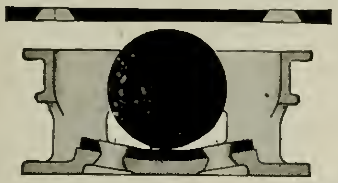

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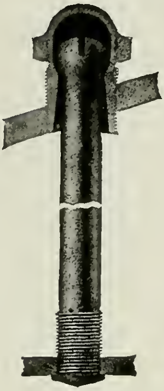

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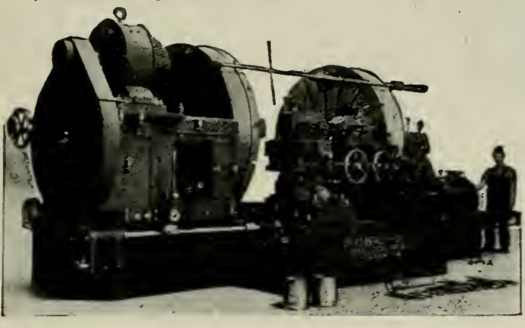

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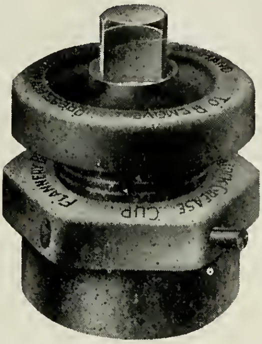

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No. 3

Pittsburgh, Pa., Jan. 26, 1922

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F. H. STARK	November, 1905,	to October, 1907
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J. A. SPIELMANN	November, 1918,	to October, 1919
H. H. MAXFIELD	November, 1919,	to October, 1920
F. J. LANAHAN	November, 1920,	to October, 1921

*—Decaesed.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
JANUARY 26, 1922

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock p. m., President Samuel Lynn in the chair.

The following gentlemen registered:

MEMBERS.

Adams, Lewis
Adams, W. A.
Allan, W. J.
Anderson, A. E.
Babcock, F. H.
Bagnall, R. V.
Bartholomew, W. S.
Bell, R. P.
Berg, Karl
Berghane, A. L.
Bernoulli, W. H.
Beswick, John
Blackmore, G. A.
Bond, W. W.
Bradley, W. C.
Brower, J. E.
Brown, F. M.
Burnside, C. J.
Carbis, N. J.
Carpenter, H. D.
Chalker, A. R.
Christy, F. X.
Connell, Wm. H., Jr.
Copeland, T. T.
Cotton, C. S.
Coulter, A. F.
Crawford, D. F.
Crouser, C. S.
Cunningham, H. R.
Cunningham, H. L.
Cunningham, J. L.
Dambach, C. O.
Damore, S. A.
Daniel, J. V.
Davis, C. S.
Davison, C. R.
Donovan, J. J.
Durkin, Wm. L.
Edwards, C. H.
Emery, E.
Forrest, C. H.
Freshwater, F. H.
Gammiere, E. J.
Gibson, G. A.
Gifford, W. E.
Gilg, Henry
Glenn, J. H.
Greene, W. F.
Gross, Chas.
Gwinn, L. J.
Hale, Chas. E.
Harger, M. L.
Harney, E. L.
Harris, J. P.
Harsh, H. H.
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Hazlett, H. H.
Hoffman, C. T.
Holbrook, W. H.
Hopkins, H. V.
Hostetler, L. W.
Howe, D. M.
Huber, H. G.
Hudson, Wm. L.
Hussong, A. C.
Jenkins, R. H.
Johnson, A. B.
Jungbluth, A.
Kelly, Leo J.
Kempf, G. P.
Kinch, L. E.
Kindle, W. F.
King, S. A., Jr.

Kirkpatrick, H. F.
Kranse, H. A.
Kummer, J. H.
Lake, A. H.
Lanahan, F. J.
Landis, W. C.
Lent, John F.
Lloyd, D. W.
Lloyd, J. A.
Lobez, P. L.
Long, H. P.
Long, R. M.
Lower, N. M.
Ludgate, B. A.
Lynn, Samuel
Maliphant, C. W.
Marsh, Wm. J.
Meckert, F. A.
Meeker, H. B.
Merscher, John
Meyers, J. M.
Millar, C. W.
Miller, R. E.
Mitchell, J. H.
Murphy, W. J.
Myers, W. H.
McAninch, D. A.
McConnell, P. L.
McDermitt, E. E.
McGregor, D. C.
McKee, S. F.
McKibbin, G. E.
McKinley, Andrew
McKinstry, C. H.
McMullen, C. E.
McNulty, F. M.
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Nelson, W. O.
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Ogden, G. D.
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Patterson, J. E.
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Peirce, E. C.
Pennington, F. W.
Perry, G. M.
Phillips, W. H.
Quinn, J. M.
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Beall, C. R.
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Bennett, T. W.
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Bercan, C. F.
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Borngesser, R. H.
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Day, F. R.
Dean, W. A.
Dean, W. E.
Dornberg, G. A.
DeSellen, G. W.
Dobbs, A. E.
Downes, D. F.
Down, S. G.
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Horton, H. R.
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Hull, J. B.
Hummel, F. J.
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Krylow, J. E.
Lewis, L. V.
Lind, N. S.
Locke, H. A.
Loomis, H. S.

Masterman, T. W.
Maylock, E. A.
Mickley, J. K.
Mitchell, F. K.
Motry, G. A.
Murray, W. B.
Musser, L. J.
Mutter, John
McCoy, C. E.
McGregor, S. S.
McIntire, L. W.
McNeill, J. E.
McWhirtter, W. C.
Nangle, C. F.
Nicholson, F. H.
Ohl, C. A.
Owens, J. F.
Padmore, B. R.
Parr, C. H.
Pendleton, A. H.
Phillipi, I. N.
Pierce, H. B.
Price, M.
Quirnbach, C. F.
Rodder, P. H.
Roney, H. E.
Russell, H.
Seitz, W. W.
Sekera, Chas.
Sixsmith, G. M.
Sloan, J. R.
Smith, H. K.
Smith, M. A.
Stanton, H. L.
Stenson, G. A.
Stevens, R. R.
Stevenson, T. W.
Steward, J. E.
Stone, H. H.
Stotz, J. K.
Stull, J. H.
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Taylor, R. W.
Temple, H. H.
Thompson, H. A.
Warner, A. S.
Weaver, E. H.
Wheeler, C. M.
Whitney, T. H.
Whitney, R. T.
Willby, W. H.
Wilson, L. H.
Wolf, H. E.
Wright, James
Yearick, R. O.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Adams, Walter A., Clerk, P. & L. E. R. R., 720 Vermont Avenue, Glassport, Pa. Recommended by John Merscher.

Blackmore, G. A., Vice President, Union Switch & Signal Co., Swissvale. Pa. Recommended by J. B. Wright.

Boss, Raymond E., Baggage Master, Pennsylvania System, Box 131, Elrama, Pa. Recommended by J. V. Moran.

Ceska, George C., Mechanical Engineer, Whitman & Barnes

Mfg. Co., 1417 Tolma Avenue, South Hills Branch, Pittsburgh, Pa. Recommended by J. D. Conway.

Donovan, Edward J., Passenger Conductor, Pennsylvania System, Apt. 2, 401 North Rebecca Street, Pittsburgh, Pa. Recommended by G. A. Gibson.

Down, S. G., General Sales Manager, Westinghouse Air Brake Co., Wilmerding, Pa. Reccommended by J. B. Wright.

Doyle, William E., Assistant C. C., P. & L. E. R. R., 916 Dohrman St., McKees Rocks, Pa. Recommended by Samuel Lynn.

Foster, F. L., C. C. to Supt. Freight Transportation, P. & L. E. R. R., 508 Woodward Avenue, McKees Rocks, Pa. Recommended by Samuel Lynn.

Gates, H. D., Service Engineer, The Pilliod Co., 215 Washington Avenue, Dunkirk, N. Y. Recommended by Joshua Partington.

Herron, Guy C., C. C. to Supt. Teleg., P. & L. E. R. R., Room 64, P. & L. E. Terminal Annex Bldg., Pittsburgh, Pa. Recommended by H. R. Richardson.

Hildenbrand, L. B., Asst. Gen. Car Foreman, P. & W. Va. Ry., 601 Griffith Street, Mt. Washington, Pittsburgh, Pa. Recommended by H. F. Patmor.

Jenkins, R. H., Rep., Nathan Mfg. Co., 21 East 40th Street, New York City. Recommended by F. M. McNulty.

Lee, L. A., Supt. Teleg., P. & L. E. R. R., Room 64, P. & L. E. Annex Bldg., Pittsburgh, Pa. Recommended by H. R. Richardson.

Miller, Louis A., Jr., Trav. Auditor, Westinghouse Elec. & Mfg. Co., 7319 Race Street, Pittsburgh, Pa. Recommended by J. H. Tummon.

Mitchell, Frank K., Signal Inspector, P. & L. E. R. R., Room 55, Terminal Annex, Pittsburgh, Pa. Recommended by H. R. Richardson.

Mitchell, John H., Standard Steel Car Co., Frick Bldg., Pittsburgh, Pa. Recommended by Samuel Lynn.

O'Toole, J. L., Supt. Freight Transportation, P. & L. E. R. R., 612 P. & L. E., Terminal Bldg., Pittsburgh, Pa. Recommended by F. G. Minnick.

Pierce, H. B., Asst. Supt., Monongahela Railway, Brownsville, Pa. Recommended by H. R. Richardson.

Temple, H. H., Gen. Supt., P. & W. Va. Ry., 339 Wabash Bldg., Pittsburgh, Pa. Recommended by H. R. Richardson.

Watts, J. J., Engineman, P. & L. E. R. R., 707 Frederick Street, McKees Rocks, Pa. Recommended by C. O. Dambach.

PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

Announcement was made of the death of Don H. Amsbary, for many years Chairman of our Entertainment Committee who died January 25, 1922.

Upon motion Messrs. Frank J. Lanahan, E. Emery and Henry F. Gilg were appointed as a Committee to draw up suitable resolutions to be spread upon the minutes of the Club and a copy of same to be sent to the wife of our deceased member.

There being no further business, Mr. L. V. Lewis, Train Control Engineer of the Union Switch & Signal Company, presented the paper of the evening upon the subject:

AUTOMATIC TRAIN CONTROL

By Mr. L. V. Lewis, Train Control Engineer Union Switch and Signal Co.

Mr. President, Members of the Pittsburgh Railroad Club and Guests:

The subject of automatic train control, which has so long been a matter for study and investigation by government agencies and individuals, has now entered upon a new phase with the recent order of the Interstate Commerce Commission to show cause why train stops or train control devices should not be installed, and has become of immediate general interest.

The need for train control does not exist because of the failure of signal systems to function properly, but has its source in a growing recognition of certain psychological deficiencies of the human mind functioning under certain special conditions.

In a paper before the New York Railway Club last year, there was given a list comprising a sequence of eighteen operations involved in stopping a train due to an obstruction on the track ahead. The first seven operations are performed by the signaling system, operating on the closed circuit principle, whereby the stop indication is produced by the force of gravity in response to the removal or reduction of current, or by the opening of a normally closed circuit. The last six operations are performed by the air brake system in a similar way, by the force of stored air pressure acting in response to the venting of air pressure to atmosphere. The five steps in the process performed by the engineman—seeing the signal, sensing and interpreting the indication, deciding to stop, shutting off power, and applying brakes—all require effort and the expenditure of energy, and, hence, are analogous, in effect, to the unsafe "open circuit" principle.

There has, therefore, arisen a demand for something to bridge the gap between the signaling system and the air brake, between the track and the train, which must unite the signal system and the air brake in a single harmonious whole, operating on the same "closed circuit" principle throughout, so that a failure can only result in stopping the train.

The Union Switch & Signal Company has been a pioneer in the development of automatic train control, its efforts dating from the purchase of the well known Wood patent of 1883, covering the overhead glass tube automatic stop. The Union Company has subsequently made a number of notable installations of automatic stops of the trip arm type, including the New York Subways, the Philadelphia Subway and Elevated Railroads, the Boston Subway and Elevated Railroads, and the New York Terminal of the Pennsylvania Railroad. We have been directly engaged in the study of the major problem of train control for general steam road conditions for a number of years. The system we have developed, and which I am going to describe, has been made the way it is in order to comply with requirements and principles which we have felt to be vital, and I would, therefore, like to discuss these principles first of all in order to make clear why our system is designed the way it is and why we feel that half-way measures will not answer.

Our first fundamental requirement is that the automatic train control device should be installed so that it does not interfere with proper control of the train by the engineman and does not detract from his responsibility. It should act in such a way that the engineman is left in full charge of his train, and has full responsibility for handling it, and it must only act in case the engineman fails.

To get the best results from the engineman; in fact, to maintain the excellent results that we are now getting, we must depend upon him and hold him responsible for proper train handling. This is fundamental, and with this accomplished and automatic train control added, we have the automatic features to fall back on if the engineman fails, and our chances of failure are reduced to the very remote contingency of the failure of both at the same time—a chance that is more remote than the chance of failure of either alone.

Now, to show how this can be accomplished, we will assume, first of all, that we have an automatic block signal system, since it should be obvious that automatic train control is an adjunct to, and does not replace, a signaling system, and, in what follows, we have assumed that the necessity for signals is recognized. We will install an automatic stop so that it will be effective to apply the brakes if the train passes a caution signal. We will also provide a valve in the engine cab which can be easily operated by the engineman to cut out the automatic stop and render it ineffective provided he does it *just before* passing the caution signal. Thus, at each caution signal, he is given the opportunity to show that he is awake and alert, and, by so doing, he retains control and responsibility for control of the train. If he fails to acknowledge the caution signal, the train is stopped. Instead of asking the engineer to do less, we have asked him to do one thing more—to prove that he is alive at each caution signal, and the automatic stop does not act unless the engineman fails in his responsibility for the control of his train.

The second fundamental is the use of the "closed circuit" principle. A paramount requirement of automatic train control is the requirement of safety, and yet the usual idea of an "automatic stop" embraces a principle diametrically opposed to the idea of safety, because it requires the transmission of some sort of a signal or impulse from the trackway to the train to stop the train. To transmit an impulse to the train to stop the train in such a way that the failure of the impulse will stop the train is obviously a paradox. In other words, the "automatic stop," in the ordinarily accepted sense of the term, is inherently an "open circuit" device.

The application of the "closed circuit" principle to automatic train control requires that the system be so designed that a signal is transmitted to the train to *permit it to proceed*, and in such manner that a failure to transmit the signal will result in stopping the train.

The third fundamental is that of "continuous control."

The track circuit is the fundamental basis of railway signaling as it exists today, and we should, therefore, consider the relation of automatic train control to the track circuit. We may question the value of any train control system in which track circuits are maintained continuously effective twenty-four hours of the day but in which the signal indications given by them on the train are available only for an instant now and then as a train passes over a contact rail, or the like, and the rest of the time train's may run along at full speed without control. The necessity for keeping the train responsive to conditions in advance is just as great at one time as another, and with the train at one place as at another. Unless automatic train control can take advantage of the principles of the continuous track circuit, it will have failed to fully attain the standard of safety set by the present day signaling system.

Under our present system of signaling, the "proceed" indication is very often given by a signal at a point where the next signal in advance is not visible. In fact, the first signal, the so-called "distant" signal, is a "repeater" of the signal in advance, indicating "proceed" when the latter indicates "proceed," or "caution" when the latter indicates "stop." The distant signal is a necessity for high speed running because of the lack of visibility of the signal ahead. The indication of the "distant" signal is, nevertheless, lost as soon as it is passed, and, for a time, the signal ahead may not be visible.

With continuous control, a train, having accepted a restrictive signal, is at all times prepared to immediately resume speed as soon as the advance signal clears, whether it is visible or not.

The fourth fundamental is the requirement of continuous track circuit protection, by which is meant that the section of track which governs the train should include the track rails directly in advance of the train.

The track circuit, controlling a signal, should extend right up to the signal. With train control, one signal is on the train; hence, the track circuit control should extend right up to the pilot of the moving train. In our system, we accomplish this because we control the train by induction from current in the track rails ahead of the train, and this current is the track circuit current of the block signal system.

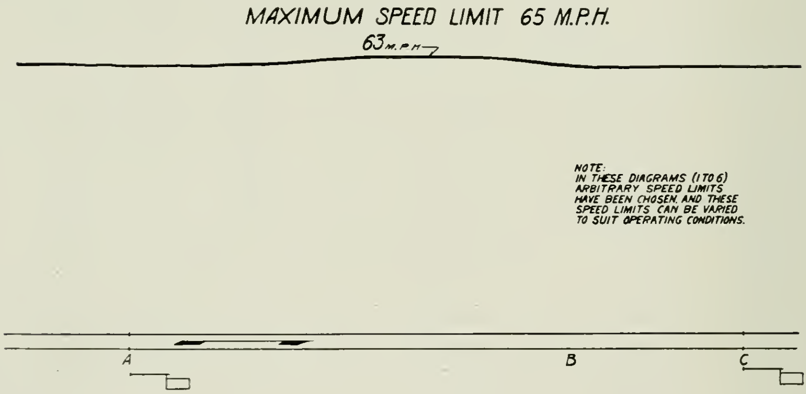
We may illustrate this point in this way:

In order to be thoroughly safe, any train control system should meet the requirement that a pair of wheels on an axle, making contact with the two rails, placed anywhere on the track ahead of the train, should result in the display of a "stop" signal, or its equivalent, on the train, or in stopping the train. To meet this test, it is obvious that the track rails must be the conductors which convey the signals to the moving train. The use of the running rails as the medium of communication between trackway and train is, therefore, important from the standpoint of safety, aside from its practical advantage of avoiding the use of any special devices along the track to interfere with clearances or with track maintenance.

An important function of train control is as a safeguard against accidents due to excessive speeds; in fact, "train control" and "speed control" are, in a sense, synonymous, since the only control the engineman has over his train is the control of its speed. The function of train control may be logically extended beyond its fundamental purpose of protecting against occasional unavoidable human failure, to protecting against errors in judgment in running at speeds which are excessive and incompatible with traffic conditions.

The accompanying diagrams, Fig. 1 to 6 inclusive, illustrate the principles of "speed control"; the figures indicating speed are merely illustrative. Where reference is made to speeds of 65, 40 and 15 m. p. h., these refer to passenger service. Lower speed limits will be employed in freight service and changes in locomotive speed adjustments can be readily made under proper conditions by authorized persons.

Signal "A" is always shown giving the indication displayed to the train approaching it. Fig. .1 shows at the bottom a typical section of track comprising one block equipped with automatic block signals, standing at "proceed." The upper portion is a "speed-distance" diagram, the distance between the track and the upper line representing the speed of a passenger train as it runs through the block. In Fig. 1 the train is running at full speed under "proceed" signals.



NOTE:
IN THESE DIAGRAMS (1 TO 6) ARBITRARY SPEED LIMITS HAVE BEEN CHOSEN, AND THESE SPEED LIMITS CAN BE VARIED TO SUIT OPERATING CONDITIONS.

FIG. 1.

Fig. 2 shows the same block condition as Fig. 1. In order that the signals may be effective, it is evident that the maximum speed of the train should be limited so as to enable it to stop in a distance less than the length of the block, with a reasonable safety factor. Therefore, a "maximum speed limit" is provided, whereby a full service application of the brakes is made automatically if the train, when running under clear signals, exceeds a maximum speed.

When the brakes are automatically applied, they remain applied until the train speed is reduced a definie amount, when they *may* be released manually. By thus making the release of the brakes non-automatic, an additional check on the engineman is provided for the automatic speed control will act to bring the train to a full stop when the maximum speed limit is exceeded under clear signals unless the brakes are released by the engineman.

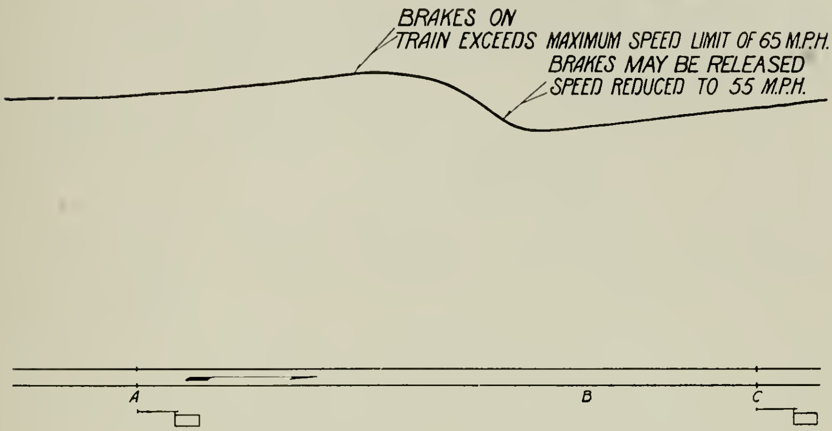

BRAKES ON
TRAIN EXCEEDS MAXIMUM SPEED LIMIT OF 65 M.P.H.
BRAKES MAY BE RELEASED
SPEED REDUCED TO 55 M.P.H.
A
B
C

FIG. 2.

In Fig. 3 it is assumed that there is an obstruction in the block in advance so that signal "C" indicates "stop" and signal "A" indicates "caution," or "proceed, prepared to stop." If the engineman fails to see signal "A" and to operate his acknowledging valve just before passing "A," the brakes will be applied at "A" and the train brought to a stop with a single full service application.

If the engineman acknowledges the "caution" signal "A," an automatic service application of the brakes will be made if the train speed is above a predetermined medium speed of, say, 40 m. p. h., but the brakes may only be released manually when the speed is reduced to this value. The train may then continue through the block at this speed until a point "B," somewhat more than braking distance from the end of the block for this speed, is reached. At point "B" a service application of the brakes will be made to bring the train to a stop before passing signal "C."

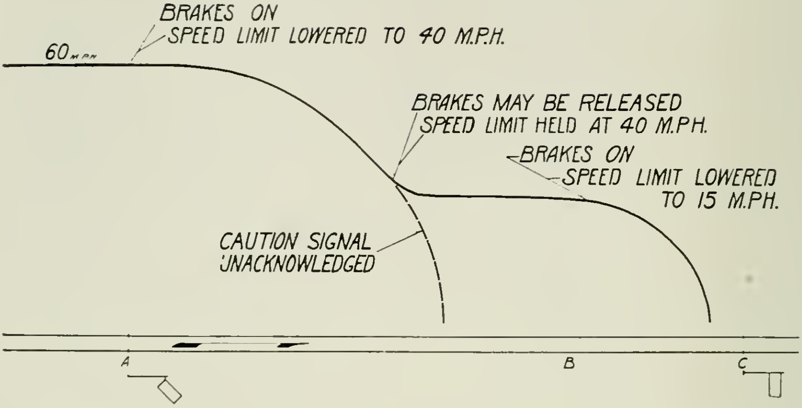

BRAKES ON
SPEED LIMIT LOWERED TO 40 M.P.H.
60 M.P.H.
BRAKES MAY BE RELEASED
SPEED LIMIT HELD AT 40 M.P.H.
BRAKES ON
SPEED LIMIT LOWERED TO 15 M.P.H.
CAUTION SIGNAL UNACKNOWLEDGED
A
B
C

FIG. 3.

The approach of a high speed train to a stop signal is thus governed by the desirable "two-application stop" method, wherein the "factor of safety," representing the difference between stopping distance and block length, appears as a free running period between two consecutive brake applications.

Fig. 4 represents the same block as Fig. 3, and the same conditions, except that it is assumed that after the train has passed signal "A," the obstruction in the block in advance is removed, permitting signal "C" to go from "stop" to the

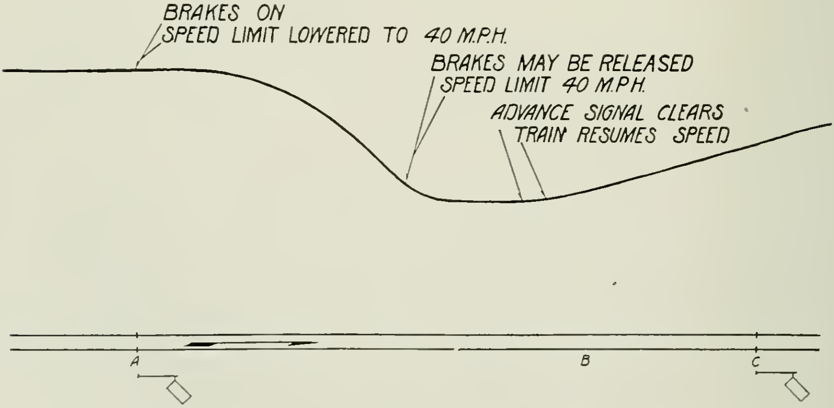


FIG. 4.

"caution" position. The train is continuously controlled by traffic conditions in advance; therefore, the engineman may at once release the brakes, if applied, and may immediately resume speed, wherever the train may be. *Continuous control* thus contributes to maximum traffic capacity.

Conversely, when running under a "proceed" signal, as in Fig. 1 or 2, if, for any reason, signal "C" is suddenly thrown to "stop" as in Fig. 3, this change immediately results in an application of the brakes to bring the train to a stop. *Continuous control* thus secures maximum safety under emergency conditions.

Fig. 5 illustrates the same traffic conditions as Fig. 3. After the train has been brought to a stop before passing signal "C," the brakes may be released, and the train may proceed at a low speed, limited to, say, 15 m. p. h., and may enter and pass through the block in advance of signal "C," prepared to stop short of any obstruction.

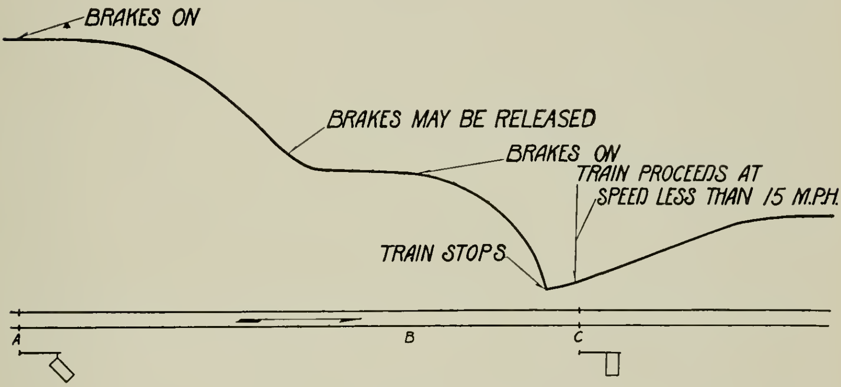


FIG. 5.

Since the train is *continuously controlled* by traffic conditions in advance, the low speed restriction is removed wherever the train may be in the block, and the train may, therefore, resume speed, as soon as the obstruction is removed, and traffic conditions permit.

Fig. 6 also illustrates the same traffic conditions as Fig. 3. In this case, the train passes the caution signal "A" at a speed less than the medium speed limit in the caution block, in which case, the brakes are not applied until point "B" is reached, whereupon the stop is made with a single application. However, if the engineman fails to acknowledge the caution signal by opening a valve before passing the signal, the brakes will be applied at "A" as in the case of the high speed train.

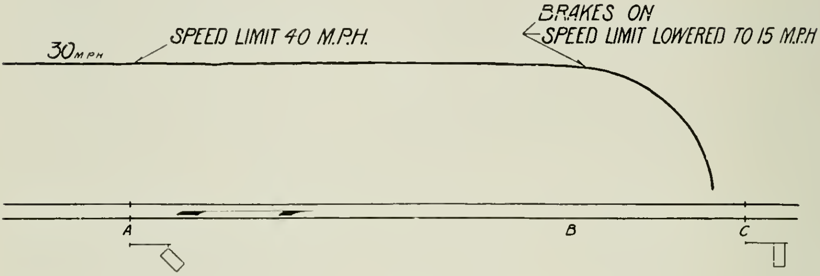


FIG. 6.

If the brakes are applied due to the engineman's failure to acknowledge a caution signal, they may be released as soon as the train is stopped.

The speed control system, therefore, provides three fixed speed limits—"high," "medium" and "low," corresponding closely to the three indications "proceed," "caution" and "stop" of the automatic block signaling system. The cab equipment may include a speed limit indicator showing the permissible speed limit established by the train control system. The control of the speed is by means of a centrifugal speed governor, connected by a propeller shaft type of drive to an axle of the locomotive. The control of the brakes by the governor is purely pneumatic, by means of the same type of valves as are used in existing air brake equipment. The governor is controlled by two magnets, which are, in turn, controlled by a three-position a-c. relay on the locomotive, designated the "train control" relay, which is controlled by induction from the track circuit current in the track rails ahead of the train. This relay is of the same type, and functions in the same manner, as the track relay of the block signaling system.

PRESIDENT: In view of the fact that some 49 railroads have been listed by the Interstate Commerce Commission to show cause why they should not equip certain portions of their lines within a reasonable time with train control devices, this subject is a very live one. There are a number of signal, track and locomotive men here who will wish to discuss this subject. I will first call upon Mr. L. F. Howard, Chief Engineer, Union Switch & Signal Company.

MR. L. F. HOWARD: Mr. Chairman, Members of the Railway Club of Pittsburgh and Guests:—Mr. Lewis will testify that during the past few years while he has been working on this subject I have amply demonstrated Emerson's saying that a man is just as lazy as he dares to be. I have left all the creative work to him and his assistants and as a consequence I am probably in rather poor condition, comparatively, to contribute to this discussion.

Mr. Lewis has described our system quite fully and really the best I could contribute to the discussion would be to ask you to carry away with you certain fundamental principles that we have incorporated in this system in view of the experience we have had with signal matters and train operation in the conduct of our signal business extending over a very long period of years. We have been especially fortunate in being associated with the Westinghouse Air Brake Co. so that they could supplement our knowledge of signals by their knowledge of air brakes and the proper functioning of the air brake with relation to the train operation. This has been an asset of almost inestimable value because a train control system can not be a system which simply punches a big hole in the brake pipe. Every operating man knows what the dangers are incidental to such a procedure. So we have devised a means for getting the information aboard the train and providing apparatus which would act in conjunction with that provided by the Westinghouse Air Brake Co. so that the operation of the brakes, even though automatic, would be accompanied by exactly the same degree of safety in train operation as is experienced when the brake valve itself is handled by a competent engineer.

So far as fundamental principles are concerned, signaling itself as you know started from a rather primitive stage. The simple start of signal apparatus was the stop signal. All that did was to stop the train. It meant that the absence of a signal meant to go ahead. That was obvioulsy deficient. The next step was to add a proceed signal. If a man had a stop signal and the train was just beyond that signal he sometimes found that he could not stop quickly enough. If it was foggy he might not see the signal soon enough, and if he did not have braking distance he might run by and bump a train. So a caution signal was added, and the caution signal is really the important signal today. That is the one that tells a man that he has a clear block ahead of him and in that clear block he has to bring down the speed of his train so that when he gets to the stop signal which is protecting the train ahead he can stop and the train ahead is safe. That is why we initiate the braking at the caution signal. We have included there the underlying and fundamental principles of modern up-to-date signaling as they have been developed through these years of experience. We feel that here is a signal system that has been developed through long experience and we are not going to start back where signaling was a number of years ago and then bring automatic train control up through those same stages. That would be foolish The thing to do is to start in where the fundamental signal system is today.

Another important thing was the track circuit control. In the old days there were no track circuit control signals, they were all manual control, and the information was transmitted from block to block by telegraph and the operators depending on the information they received gave a proceed or stop signal as the case might be, depending on whether the block was clear or occupied. That had its fundamental objections and the track circuit was proposed as a cure. With a track circuit the signal is always under continuous control just as long as the train is on the rails, which conducts the current to the apparatus primarily operating these signals. So we said if the train control was to be a supplement to an already very good signaling system it would have to have the same safety elements in its control. So we utilized the track circuit to give us continuous track circuit control. .

Then there is the other point Mr. Lewis mentioned, of not detracting from the responsibility of the engineer. Suppose you put an automatic train control on a section of the main line and so arranged that it was perfectly safe. There is no such thing as absolute safety, but assume that there was. Suppose the runner runs under that method until he becomes entirely accustomed to it. Then he goes to some section where you have no automatic train control. He is a dangerous man right away because, having had everything done for him, he has become lax. So in our train control system, as we have developed it, we require the co-operation of the runner with the automatic apparatus so that the two have to act conjointly.

Then we put a further check on him. We may brake his train automatically, but we do not release the brakes automatically. When he does not acknowledge his caution signal and is brought down to a limited speed, or stop, he can not get away until he releases the brakes. We do not release the brakes automatically for him, thus securing another check on his being alive and on the job.

There is one other point that I have not mentioned. We carry the control circuit over the rails. Mr. Lewis pointed out that the absence of current would give him his stop. By carrying the current over the rails that way you have utilized means that can not result in any false clear failure on account of anything being removed. This is not the case if you have a piece of equipment that you are depending on to stop your train, ,and which will not stop the train if it is not on the right of way. So we have these fundamental principles of forcing an acknowledgment of the signal, compelling the man to release his brakes if they are once applied, all pertaining rather more to vigilance on the part of the engineer than otherwise, and then we have the continuous track circuit control. I think that is all I have to contribute.

PRESIDENT: We would like to have some railroad men speak. Mr. D. F. Downes, Division Operator, Pennsylvania Railroad.

MR. D. F. DOWNES: Mr. Chairman and Gentlemen: I came here to get a little information. I was rather impressed with the diagrams and the information they gave, but I do not understand yet quite how this current is picked up by the train from the track.

MR. L. V. LEWIS: The action is by electromagnetic induction, just as in a transformer. We may consider that the rail is the primary of the transformer. The magnetic lines of force surround the rail and the secondary is placed in front of the front wheels so as to be in the field of magnetic force.

The contact is through magnetic force; there is not any direct connection.

MR. D. F. DOWNES: Is this for main track operation altogether or would it be considered in operating through yards where there is constant shifting going on?

MR. L. V. LEWIS: All tracks on which high speed service is maintained should be equipped. Usually that means only one or two tracks through a yard. Trains can always run without control current at fifteen miles an hour or less so that it is not necessary to equip yard tracks for low speed moves.

MR. D. F. DOWNES: I would think main track operation is perfectly all right, but when a matter of shifting is being done, it would put too much burden on the shifter engineer.

MR. L. V. LEWIS: I believe that you will find that this is not the case because shifting movements would be made at restricted speed.

MR. D. F. DOWNES: What actual experience have you had in practice with this train control apparatus?

MR. L. V. LEWIS: It is entirely new. We expect to have it on a railroad shortly. We have a full size demonstration at Swissvale and we would be glad to extend to any of you an invitation to come out and see it at any time.

PRESIDENT: We would like to hear from Mr. I. S. Raymer, Signal Engineer, P. & L. E. Railroad.

MR. I. S. RAYMER: Railroads, as is well known, manufacture transportation, and the cheaper the transportation can be manufactured, the cheaper it can be sold. If new apparatus can be used on railroads that will help to keep trains moving, providing this apparatus is not too expensive, it is to the interest of the railroads to install it.

Automatic train control, if used on the railroads, will change one or two features to the advantage of operation. The derail, a well-known apparatus, is used on main tracks at interlocking signals to run the locomotive off the rails on to the ground if the engineman does not stop his train at a stop signal. It will be remembered that a serious accident occurred at a grade crossing between the Michigan Central and the New York Central at Porter, Indiana, caused by a Michigan Central passenger train running past an interlocking signal indicating stop, through the derail and on to the ties, and stopped with the train on the crossing. . A fast N. Y. C. passenger train, receiving the clear signal, plowed through the M. C. train. With an efficient automatic train control in use at this point, this accident no doubt would not have occurred. It is believed by signal men that when the automatic train control is in use, all main track derails can be eliminated. .

The stop and proceed rule requiring all trains to stop at an automatic signal when it indicates stop, then proceed through the block under control, expecting to find the block occupied, a switch open or some other obstruction, can, it is believed, be eliminated. Under this rule a train stopping at an automatic signal in the stop position can proceed and may increase its speed to an unsafe rate with an obstruction in the block. Under an efficient automatic train control a train should not be required to stop at an automatic block signal indicating stop, on account of this train being automatically held down to a safe rate of speed while passing through the obstructed block. This feature will be of special benefit to tonnage trains in that they can be kept moving under control into an obstructed block where the stopping of the train might develop into stalling, pulling of the drawhead, and thereby tying up traffic unnecessarily. The eliminating of the main track derail and the stopping of a train at an automatic signal in the stop position are decided advantages in favor of the automatic train control.

The automatic train control will be a very expensive improvement and railroad men are somewhat at a loss as to how the money will be obtained should they be forced to purchase this additional protection. The losses of lives of patrons of the railroads are very few as compared to fatal accidents on our streets and in our industries. If the railroads are required to make an expenditure for automatic train control having questionable merit, the maintenance of rolling stock, road bed and bridges may have to suffer, which would bring in a hazard greater than the automatic train control would remove. At the present time the railroads are not selling enough transportation to meet the demands of maintenance and train control improvements.

PRESIDENT: We would like to hear from any other gentlemen.

MR. G. M. PERRY: How expensive is this installation going to be that Mr. Lewis mentions?

MR. L. V. LEWIS: It is not going to be very expensive as far as the track equipment is concerned. I am not prepared to say just how much it is going to cost.

MR. W. B. RUDD: I would like to ask Mr. Lewis what happens if the headlight generator falls down, that you have no current delivered from the generator..

MR. L. V. LEWIS: The failure of the headlight generator will cut off the train control current and limit the speed to fifteen miles per hour.

MEMBER: I would like to ask what is proposed where the present signals are operated on direct current. Mr. Lewis says the train control system is operated on alternating current. What arrangement has he in mind for operating with direct current signals?

MR. L. V. LEWIS: When used with alternating current we use the same track circuits as used with the signal system but on a direct current system we superimpose a small amount of alternating current. We still require alternating current in train control but it could be applied to direct current block signals as well as alternating current. With the alternating block signal we use the same current. With the direct current system we add a small amount of alternating current for train control only. The small amount of alternating current required for train control would not interfere in any way with the battery or relays of the direct current system.

MR. L. F. HOWARD: I do not want to trespass upon your time but that question Mr. Rudd asked suggests something to me. You will remember that you can run anywhere at fifteen miles an hour or less, so that after a failure of the current on the engine or the failure of a track circuit you can still go on at the rate of fifteen miles an hour. It is optional with the user as to whether he will put on some form of sealed cut-out which would cut out the train control entirely, but even though your current fails, your speed control imposing the fifteen mile an hour limit is still effective. .

With regard to Mr. Raymer's remarks regarding the passing of the signal, Mr. Lewis' diagram showed the train as coming to a stop at the stop signal. The system is flexible in this respect so that it could be arranged to give you three options. You could either bring your train to a stop at the stop signal, release the brakes and then proceed at less than the low speed limit, or, as Mr. Raymer suggests, it can be arranged so that you can pass the stop signal without coming to a full stop, providing you are below the low speed limit; or it can be arranged so that the train will be stopped if the stop signal is not acknowledged and so that the train may pass the stop signal and continue through the occupied block at low speed only in case the engineman acknowledges the signal and takes the responsibility for so doing.

MR. J. R. SLOAN: I would like to ask what additional demand is imposed on the headlight generator.

MR. L. V. LEWIS: About 100 watts.

MR. J. R. SLOAN: I understood a mercury vacuum tube would be used.. That is a very delicate apparatus. What provision has been made to take care of the shocks and vibration?

MR. L. V. LEWIS: It is not a mercury vacuum, it is what is known as a vacuum tube relay, the same little piece of apparatus used in radio work and in long distance telephone circuits. These are exceedingly rugged for that kind of apparatus. They have a filament which is a low voltage thick filament and it is fully as strong as the filaments used in the locomotive head light. Then we suspend the lamp base on an elastic suspension and the entire mechanism case, including the relay, is suspended to take care of vibration.

MR. J. R. SLOAN: Is there any provision, assuming an error in the use of this system, is there any provision made whereby his supervising officer will know about that condition?

MR. L. V. LEWIS: The only thing it will do for him is to stop him. We have not considered applying any recording or indicating device. The only penalty is a train delay, due to his failure to keep in control of the train. Of course recording devices can be put on without difficulty if there is any advantage in doing so.

PRESIDENT: We have some operating men present. Mr. F. M. Brown, Superintendent, P. & L. E. Railroad.

MR. F. M. BROWN: I listened with a great deal of interest to the presentation of the subject of automatic train control. I was privileged about a year ago to visit the Union Switch & Signal Company's plant togethed with other operating officials to see a practical demonstration of the apparatus under discussion and to my idea it seemed to fill all of the conditions any operating men could expect. The demonstration consisted of a section of standard track representing a mile with a car geared in such a way as to represent a speed of sixty miles an hour, this was coupled up with standard air brake apparatus and signals which worked in unison and demonstrated all the functions of the device. One particular feature that impressed me most forcibly was the possibility of an engineman accepting the signal in the clear or proceed position and after passing it in such a position track was fouled or switch opened and the device immediately functioned by makking service application. Another feature of interest was the possibility of applying variable speeds to meet different requirements of the traffic.

Inasmuch as Mr. Lewis has extended an invitation to the members of the Railway Club to view a practical demonstration of the apparatus I would strongly urge the members of this club to avail themselves of this opportunity as, to my mind, it is astonishing what they have accomplished, and I know that anyone taking the trouble to make this visit will be amply repaid by the demonstration.

Another feature that appealed very strongly to me was the fact that the engine or train does not come in contact with any ramp or trip in order to operate the device as obtains in some of the other automatic train control systems which it would seem to me is very much in favor of the device under discussion.

MR. L. V. LEWIS: There is one other point that has occurred to me, which has not been discussed, in connection with carrying the system through interlockings. In going through an interlocking there is usually but one high speed route over any one track and there may be one or more medium speed routes. The majority of diverging routes are usually low speed routes. High speed and medium speed routes require train control. We take care of these by controlling the circuits over the levers of the interlocking machines in just the same way as we now take care of our signal controls. We select the route according to the position of the switches. In connection with the track circuits you will remember that you must always run toward the source of energy ,toward the transformer. Of course where you have traffic in both directions on a single track, that requirement must be taken care of. This system can be applied to single track as well as double track and it adds very little complication to single track operation.

MR. A. E. ANDERSON: What does the engineer do from the time he comes in sight of the caution signal in connection with this valve?

MR. L. V. LEWIS: This valve will require the engineer to acknowledge the signal. The engineer does this by reversing a valve and then puts it back in its original position. After he puts it back, for a short interval (say ten seconds) it is effective to cut out the automatic stop feature of the train control and within that ten seconds he must pass the signal.

MR. A. E. ANDERSON: Does he have to keep his hand on that valve all the time?

MR. L. V. LEWIS; No, he reverses it and puts it back again to normal, and that is all

MR. A. E. ANDERSON: At 60 miles an hour a train is going about 95 feet a second. Suppose 100 feet before he reaches this caution signal someone does something that requires the emergency brakes to be applied. How does that affect the operation of this valve? It has been fixed for ten seconds.

MR. L. V. LEWIS: The train control does not employ the emergency brake but controls the service brake only. The signal may be acknowledged at any time within the ten seconds. In connection with the electric trains on the New Haven, it has been found that there is no difficulty in doing something within a reasonable distance of a signal. They have to do it up there as they have to lower the pantograph to take a crossover. They find they can do that on the electric train without difficulty at full speed.

MR. A. E. ANDERSON: It seems to me you are adding to the burdens of an engineer who has already too many things to think about.

MR. W. L. HUDSON: I would like to ask Mr. Lewis what would happen with a signal failure on the track.

MR. L. V. LEWIS: The train control gets its control directly from the track. It is not wholly dependent on the signal. It is to a certain extent.

MR. L. F. HOWARD: Possibly I might add a little by saying that where we apply the brakes in case the man does not perform as he should, we take nothing away from the enginer in his ability to handle the train at his own will in the way of making brake applications. We may apply the brakes but we do not stop him from applying them. He can always use his emergency and service applications just the same as he would if there was no train control on the engine.

MR. A. E. ANDERSON: The question was whether he had the time to do it.

MR. W. L. HUDSON: I understood, in answer to my first question, that the brakes would apply after the train entered the block that was occupied by the preceding train, in case of a clear signal. Then why not do away with the block signal altogether and depend on the train ahead applying the brakes in sufficient time?

MR. L. V. LEWIS: The proposition of doing away with the wayside signal is rather a large subject. One phase of the matter is, suppose you did away with the block signals entirely and depended wholly on train control. That would mean that if we have a failure of the train control apparatus, the signals being on the train, the train would have no signal protection over its entire division. While wayside signals being localized, a signal failure means a failure at one point that would delay the train a minute or two and that is all. If we had cab signals only and had signal failure that train would have no protection over the entire trip. Another factor is that there are so many things outside that the engineer is required to look after other than signals, that it is very important to concentrate his attention on the outside objects.

MR. W. L. HUDSON: If the headlight generator would fail the best you could do would be to proceed at fifteen miles speed. That would really necessitate on a busy road the exchange of locomotives or a tie-up in traffic for fifty miles from terminal to terminal. That would result in just about the same thing that would happen if you did away with your block signals and depended on the train ahead to take care of you. If your train control apparatus became inoperative you would simply have to run according to range of vision.

MR. L. V. LEWIS: We have provided a sealed cut-out that can be used to cut out the train control. We want to arrange it so we do not have to depend wholly on the train control but depend on the engineer as long as he is responsible.

PRESIDENT: I am going to call upon a locomotive man to close the discussion. Mr. D. F. Crawford.

MR. D. F. CRAWFORD: You are mistaken, I am not a locomotive man. The question of automatic train control is one that is interesting from three points of view, one as a railroad man, when I was one; one as a try-to-be inventor, and the other in having some acquaintance with the development due to the fact that I have been a member of several committees that have had more or less to do with the question.

As a railroad man they have never appealed to me on account of the fact that they have always involved, until recently, the introduction of some sort of a ramp or obstruction, either above or below the locomotive, to be hit by something on top of or below the locomotive. There are many devices of such kind developed and used to some extent, as Mr. Lewis has explained, in subways and elevated service. Cab signals are in use on some of the roads in Europe, and not only are the people of the United States very much interested in this subject but the railroad people of Europe are giving the subject a great deal of attention. In the last Bulletin of the International Railway Congress which has just been received I find a description of two. And our French friends had to invent a new name for ramp and called it the crocodile.

As a try-to-be inventor I remember very well the device that Mr. Lewis referred to as the first one put on the Pennsylvania Railroad. I did not see it but I always remember the pictures being in Altoona when I was there. In addition to what Mr. Lewis spoke of, they had another accident in connection with it. The device consisted of a pipe up above the locomotive cab with a glass tube on top of it and an arm was attached to the block signal so that when the signal was at danger the arm hung out over the locomotive at sufficient height to break the glass tube. One of the young men who was following the experiments was very seriously injured trying to restore the glass tube with the air pressure on.

As an inventor myself, when by the General Superintendent of Motive Power of the Pennsylvania Railroad I was instructed about 1889 to make drawings and get out a device which would stop trains. I proceeded to do it in the wrong way. I undertook to put a big hole in the air brake pipe. In addition to that I arranged it so that it would blow the whistle. Just below the Seventh Street bridge in Altoona such an arrangement was attached to a signal in that location and the apparatus was placed on the locomotive. We ran down from Twelfth street to Seventh street and I remember well the effect of the stopping. It did not say, "Gentlemen, be seated," but seated all the observers. This caused me to abandon further experiments in that line, though I have often thought of ramps and all sorts of things of the kind. As I have become a little better acquainted with electricity the induction proposition appealed to me but I tackled that in the wrong way. I was going to put the primary the whole length of the railroad between the two rails. I knew about this primary and secondary proposition but my vision did not go far enough to do as Mr. Lewis has done and use the rail for the primary.

As to the necessity for the device Mr. Lewis has described the five actions that are not now in the closed circuit system, while it is true that on the railroads of the world where they have good signaling—and many of them do have good signaling—they succeed in making a wonderful record in preventing accidents. There is still a loop hole that it seems to me to be worth while closing.

The system described appeals to me particularly on account of one thing and that is that it is continuous. There is no ramp, no roadside apparatus—we are all more or less familiar with roadside apparatus in the present signal system—and it still leapes the engineman in charge of his train. I am satisfied that as these devices are developed they will be found to expedite traffic just as automatic signaling has been found to expedite traffic. I remecber very well the general impression when automatic signals were first generally installed, that they were looked upon as devices to retard traffic, but the impression was mistaken. I feel sure every railroad man who has had experience with automatic signals looks upon them as helpers, and the railroads need more helpers to produce cheap transportation.

PRESIDENT: Mr. Lewis, have you anything further you would like to say in closing?

MR. L. V. LEWIS: I believe not, thank you.

MR. A. E. ANDERSON: There is one thing that seems to come from Mr. Lewis' demonstration and that is that when the thing works it furnishes automatic evidence that the engine man was not on the job. This is an important question, as Mr. Crawford has remarked. In noticing the statement of the effect of these surprise tests on enginemen, they are entitled to credit for being as near perfection as seems humanly possible, and I believe they are nearer perfection than you will find in any other profession if you subject them to the same tests. But there is still left these elements of human fallibility that this automatic control is designed to clear up. In view of the paper and its discussion I think the least we can do is to give a rising vote of thanks to Mr. Lewis and his associates, and I would make such a motion.

The motion prevailed by a unanimous rising vote.

There being no further business, upon motion the meeting adjourned.

J. D. CONWAY, Secretary.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

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Official Proceedings—Railways Club of Pittsburgh, published monthly (except June, July and August), at Pittsburgh, Pennsylvania for April 1, 1922.

STATE OF PENNSYLVANIA }
COUNTY OF ALLEGHENY } ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. D. Conway, Secretary, who, having been duly sworn according to law, deposes and says that he is the Editor and Publisher of the Official Proceedings—Railway Club of Pittsburgh.

Publisher, Official Proceedings, Railway Club of Pittsburgh.

Editor, J. D. Conway, 515 Grandview Ave., 19th Ward, Pittsburgh, Pa.

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J. D. CONWAY, Secretary.

Sworn to and subscribed before me this 4th day of April, 1922. Sue B Fritz, Notary Public.

(My commission expires February 21, 1923).

In Memoriam

It is with profound sorrow and deep regret that we are brought to mourn the passing into the shadowy portals of the Great Beyond, our beloved friend and highly esteemed fellow member, D. H. Amsbary.

Sorely shall we miss that wise counsel, warm interest and unstinted co-operation in the affairs of the Railway Club, which we have been privileged to enjoy for so many years. To the duties of the Entertainment Committee, he gave liberally of the wealth of his ability and highly reputed character, and the success of our many social functions was entirely contributable to his untiring efforts and keen judgment, and the many happy hours which these affairs provided will serve as a monument to the cherished memory of our departed member.

"Don," as we all loved to call him, was favored with a disposition most affable and lovable, and it was his happy faculty ever to radiate sunshine and cheerfulness to all those with whom he came in contact. His winsome smile and kindly humor will be sadly missed from our regular meetings and in his death the Railway Club has sustained a loss that cannot be measured in words.

To the members of his family whose grief is overwhelming, do we extend our warmest sympathy, and to the surviving membership of this Club, do we commend his life as one worthy of emulation.

RESOLVED, that these resolutions be spread upon the minutes of the Club, and a copy be furnished his bereaved family as an expression of our depressed feelings in their irreparable loss.

Frank J. Lanahan,

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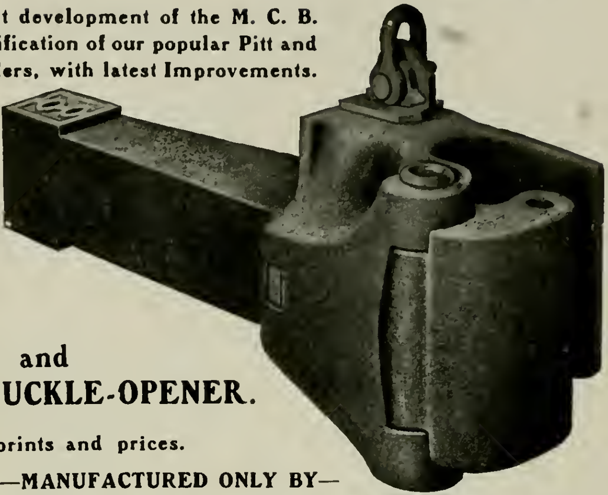

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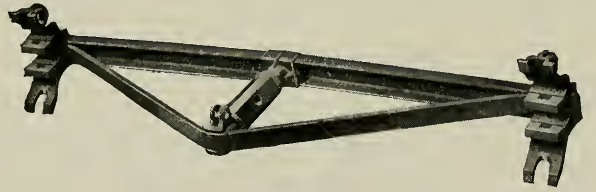

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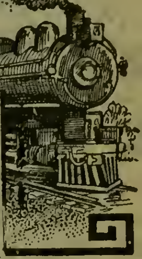

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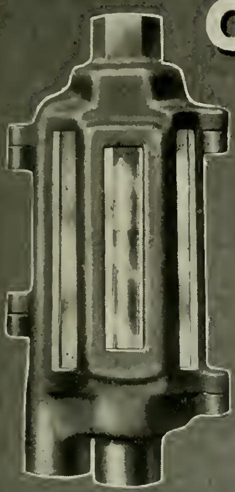

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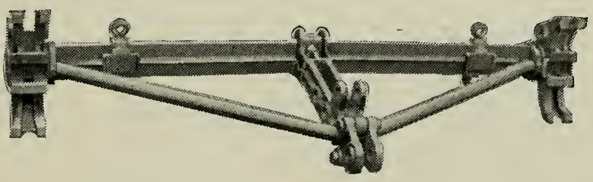

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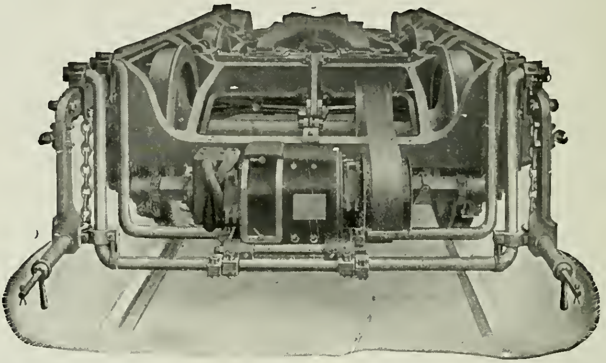

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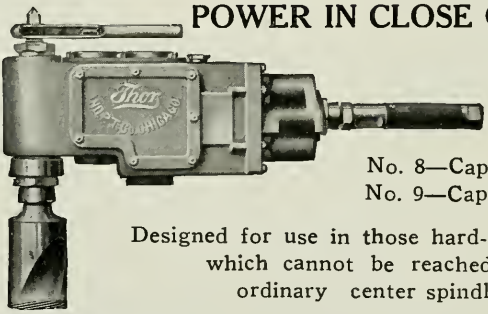

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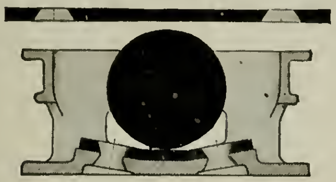

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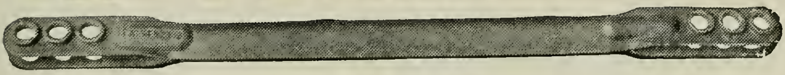

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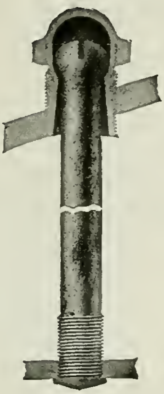

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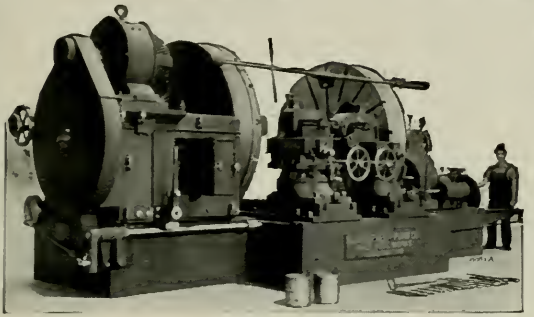

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OF
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Pittsburgh, Pa., Feb. 23, 1922

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Past Presidents

J. H. McCONNELL	October, 1901, to October, 1903
L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
D. J. REDDING	November, 1908, to October, 1910
F. R. McFEATTERS	November, 1910, to October, 1912
A. G. MITCHELL	November, 1912, to October, 1914
F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
D. M. HOWE	November, 1917, to October, 1918
J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
F. J. LANAHAN	November, 1920, to October, 1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
FEBRUARY 23, 1922.

The meeting was called to order in the English Room of the Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock p. m., President Samuel Lynn in the chair.

The following gentlemen registered:

MEMBERS.

Anderson, J. W.
Babcock, F. H.
Barratt, R. D.
Barrett, R. L.
Beals, R. E.
Bell, R. P.
Berg, Karl
Berghane, A. L.
Bernoulli, W. H.
Bird, W. G.
Blakely, W. M.
Boss, Raymond E.
Boyer, C. E.
Burnside, C. J.
Cartwright, Wm. E.
Ceska, Geo. D.
Charlton, W.
Clifford, L. R.
Code, J. G.
Conway, J. D.
Craig, J. F.
Crenner, J. A.
Cunningham, H. L.
Cunningham, R. I.
Dambach, C. O.
Daniel, J. V.
Davis, C. S.
Donovan, E. J.
Donovan, J. J.
Dorfeld, F. C.
Durant, C. H..
Edwards, C. H.
Edwards, H. F.
Elsey, W. R.
Emery, E.
Fair, Chas.
Forrest, C. H.
Foster, F. L.
Freshwater, F. H.
Fults, J. H.
Gilg, Henry
Goda, P. H.
Graham, J. A.
Greene, W. F.
Hale, C. E.
Harger, M. L.
Harney, E. L.
Haynes, J. E.
Hazlett, H. H.
Hildenbrand, L. B.
Holbrook, W. H.
Howe, C. A.
Howe, W. C.
Hudson, W. L.
Hunter, H. H.
Jefferson, E. Z.
Johnson, I. S.
Jones, E. A.
Jungbluth, A.
Kavanagh, D.
Kegel, R. C.
Kelly, H. B.
Kempf, G. P.
Kerby, F.
Kinch, L. E.
King, J. W., Jr.
Kroske, J. F.
Kummer, Jos. H.
Lang, W. C.
Lee, L. A.
Lehr, H. W.
Long, R. M.
Ludgate, B. A.
Lynn, Samuel

Maliphant, C. W.
Manning, R. E.
Maxfield, H. H.
Miessner, V. H.
Millar, C. W.
Mitchell, J. H.
Moran, J. V.
Morse, J. W.
Moyer, O. G. A.
Murphy, W. J.
McBroom, J. F.
McDermitt, E. E.
McDermitt, W. W.
McKibbin, G. E.
McNulty, F. M.
North, D. P.
O'Brien, M. J.
Ogden, Geo. D.
Olsson, N. A.
Orchard, Chas.
O'Rourke, Wm. J.
Painter, Joseph
Passino, F. J.
Paugh, Percy
Perry, G. M.
Phillips, W. H.
Pierce, H. B.
Quinn, J. M.
Rabold, W. E.
Rauschart, E. A.
Reeve, Geo.
Richardson, H. R.
Rick, R. C.
Ruben, J. W.
Rudd, W. B.
Saltic, Thomas
Sattley, E. C.
Severn, A. B.
Skuce, C. G.
Smith, F. M.
Stark, F. H.
Stevens, L. V.
Stilwell, K. E.
Stoller, K. M.
Tanner, C. J.
Ternent, H. J.
Thomas, E. K.
Thorne, H. S.
Tracey, J. B. A.
Tucker, J. L.
Tummon, J. H.
Turner, L. H.
Tutwiler, L. H.
VanVranken, S. E.
Walter, C. A.
Wilson, D. L.
Wright, John B.

VISITORS

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Bennett, E. W.
Blose, H. S.
Boyle, B. C.
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Gray, A. E.
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Kelly, E. V.
King, S. A., Jr.
Lewis, H.

Linden, C. A.
MacLaury, M. T.
Marsh, C.
Miller, Col. J. A.
Miser, C. H.
Myers, R. C.
McConnell, G. F.
Nutt, Col. H. C.
Oldroyd, W. L.
Olds, Lloyd
O'Neill, J. L.
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Shaffer, L. W.
Shriver, W. W.
Sitterly, W. H.
Smith, J. J.
Snider, Chas.
Stenson, G. A.
Tompkins, H. M.
Tuley, O. L.
Walker, J. W.
Weaver, J. R.
Wertz, P. A.
Wilson, F. S.
Work, O. A.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Barnes, H. J., Car Distributor, Conemaugh Division, Pennsylvania System, Springdale, Pa. Recommended by J. B. A. Tracey.

Burket, L. C., Resident Inspector, Pennsylvania System, 607 E. Harrison Ave., Altoona, Pa. Recommended by I. S. Johnson.

Cagney, Patrick F., Time Checker, Corrado & Galiardi, Glassport, Pa. Recommended by J. J. Donovan.

Clifford, L. R., Clerk to T. M., P., C. & Y. Ry., McKees Rocks, Pa. Recommended by E. L. Harney.

Code, Charles J., Rodman, Pennsylvania System, 220 Dewey Street, Edgewood, Pittsburgh, Pa. Recommended by H. H. Maxfield.

Dellmin, T. D., Supt., Lake Erie & Eastern R. R., Struthers, Ohio. Recommended by Samuel Lynn.

DeMoske, Charles E., Timekeeper, Pennsylvania System, 1003 Penn Ave., Pittsburgh, Pa. Recommended by J. B. A. Tracey.

Ellis, Frank I., Consulting Engineer, 2126 Farmers Bank Bldg., Pittsburgh, Pa. Recommended by Wm. H. Connell, Jr.

Goggins, J. J., Gang Foreman, Pennsylvania System, 3304 East Street, N. S., Pittsburgh, Pa. Recommended by W. J. Murphy.

Hays, R. B., Storekeeper, Standard Seamless Tube Company, 325 Hale Street, Pittsburgh, Pa. Recommended by W. J. Murphy.

Hunter, H. H., Dispatcher, P., C. & Y. Ry., McKees Rocks, Pa. Recommended by E. L. Harney.

King, S. A., Industrial Rep., Westinghouse Air Brake Co., Westinghouse Bldg., Pittsburgh, Pa. Recommended by John B. Wright.

Lascelles, William, Passenger Brakeman, P. & L. E. R. R., 1517 Water Street, South Brownsville, Pa. Recommended by S. A. Damore.

Meckert, Fred A., General Manager, Fort Pitt Spring & Mfg. Co., P. O. Box 917, Pittsburgh, Pa. Recommended by L. W. Hostettler.

Miessner, Victor H., Metallurgist, Pittsburgh Malleable Iron Co., 34th & Smallman Streets, Pittsburgh, Pa. Recommended by J. D. Conway.

Miller, George M., Gang Foreman, Pennsylvania System, 5341 Rosetta Street, Pittsburgh, Pa. Recommended by E. E. McDermitt.

Roney, H. E., Signal Draftsman, P. & L. E. R. R., 1116 Fifth Avenue, Beaver Falls, Pa. Recommended by H. R. Richardson.

Speir, Wm. S., Rep., Lufkin Rule Co., 239 McKee Place, Oakland Station, Pittsburgh, Pa. Recommended by J. D. Conway.

Sykes, Arthur, Foreman, P. & L. E. R. R., 91 Coitsville Road, E. Youngstown, Ohio. Recommended by F. H. Stark.

Ternent, H. J., Roundhouse Clerk, B. & O. R. R., 4440 Chatsworth Avenue, Hazelwood, Pittsburgh, Pa. Recommended by D. A. MacAninch.

Williamson, A. G., Signal Engineer, Pittsburgh Train Control Co., 1604 Pennsylvania Avenue, N. S., Pittsburgh, Pa, Recommended by Wm. H. Connell, Jr.

PRESIDENT: As soon as these applications have been approved by the Executive Committee the gentlemen will become members upon payment of the year's dues.

Announcement was made of the death of Joseph P. Grove, Chief Clerk, Pennsylvania System, died December 22, 1921.

PRESIDENT: Appropriation memorial will appear in the Official Proceedings of the Club.

There being no further business, Mr. Herbert Gilg entertained the Club with a piano selection and upon persistent applause gave several encores.

The President then introduced the speaker of the evening, Colonel H. C. Nutt, President and General Manager of the Monongahela and the P. C. & Y. Railroads, who addressed the club upon the subject:

"RAILWAY TRANSPORTATION IN THE A. E. F."

By Col. H. C. Nutt.

COL. H. C. NUTT: Mr. President, it affords me great pleasure and a great deal of gratification to speak to you gentlemen on a subject that may have been worn a little threadbare; but it is of such consuming interest to all of us who participated in the activities of the transportation corps in France that I thought it might possibly be of some interest to you to hear some of the more unusual features of it. I want to say, too, that those of you who were not privileged to go over at that time ought to have a sense of gratification and pride that you were able during the year and a half or two years that the struggle went on, to keep the railroads of this country going and functioning as well as they did in face of the tremendous obstacles and difficulties that confronted you. I left here in the winter of 1917-18, when things here were in anything but a satisfactory condition and I know from what conditions were then and what I have heard since of the obstacles that you had to contend with later, that while your task may have been a little bit different in kind from that of us who were over there, it was practically the same in degree. In other words, with the facilities and the tremendous traffic you had to handle with those facilities, you were almost as nearly up to the ultimate that could be accomplished as we were over there. And if you had not accomplished what you did over here in transporting men and materials all over this vast country to the seaboard, we would have had nothing to do over there. It is really the one unique achievement of the war, I believe, this organization and transportation of millions of men and the appliances, equipment, provisions, food and clothing that they required, first over the vast distances of this country and then across three thousand miles of submarine-infested water and then over five or six hundred miles of inland transportation in France.

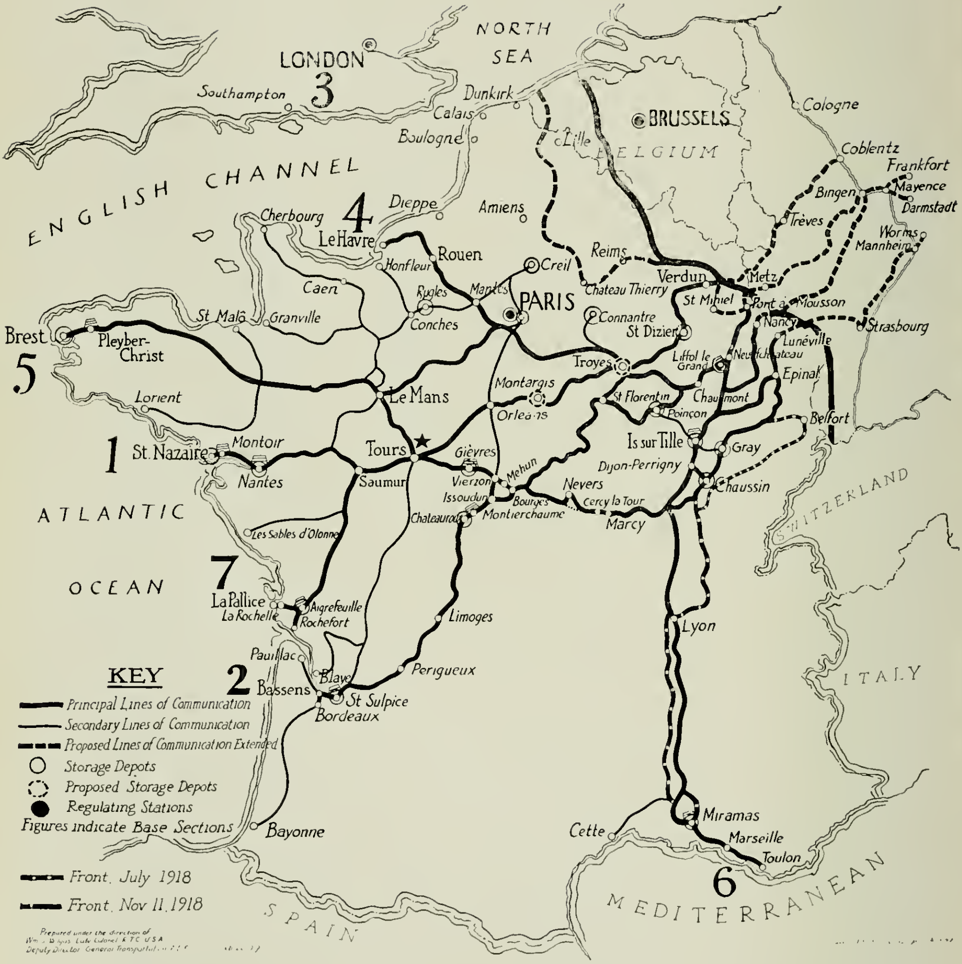
I remember one of the first interviews I had with the Chief of Staff of the Service of Supply in Tours. He expressed considerable doubt as to whether that could be accomplished. He was a regular army officer and as he looked at things combat troops on both sides were doing practically the same that combat troops have been doing ever since the time of Alexander the Great—different weapons and methods, but the principles and tactics are the same as they were ever since men began to fight in an organized way. But never before in the history of the world had it been attempted to transport two million men five thousand miles away from the base of supplies and keep them during a war, and we were uncertain as to whether it could be done or not. I think General Pershing had a very keen appreciation of the importance that railroad transportation was to bear in the solution of his problem as administrator of our armies over there, because when he went to France in June, 1917, he was accompanied, among other advisers, by Col. W. J. Wilgus, a very eminent railroad engineer, with a small staff of assistants. Upon their arrival in France the task set before Col. Wilgus was to outline a plan for railroad transportation in France that would meet the demands that even then no one knew the extent of. We had no soldiers in France, of course, and no one knew at that time whether our army over there would consist of half a million or a million or four million. Col. Wilgus had the task of visualizing the essentials in the way of equipment, tracks, materials, machines for handling freight at the docks, everything that goes to make up a complete transportation line. And with the aid of two or three men he formulated a document, known as Requisition

No. 6, in which he was able to anticipate and order from this country all the things that you could imagine were going to be needed for this tremendous army so far as transportation by rail was concerned. Many of you have had the same experience I have had in trying to anticipate the thousand and one things, big and little, to complete a project of considerable size. You know what a very difficult thing it is to do. I mention this wonderful accomplishment of Col. Wilgus because it is one of the things that made possible the accomplishment of the amount of transportation that had to be provided over there as the size of our army increased. As you look back over it it does not seem perhaps so difficult a thing to do. But imagine being over there in Paris with no idea as to what our army was going to be, and at the same time formulate this instrument in tremendous detail and do it so successfully as to meet the unheard of requirements that ultimately came. It is a lasting tribute to his genius for that sort of thing.

Not long after that General Atterbury was called to France to assume command of the engineering corps and he continued in that capacity until long after the armistice. His problem was one of an entirely different nature, in one way, and more difficult, because the human element entered into his troubles a great deal more than in the mere providing of materials for doing the work. Like everything else, the transportation corps was a growth from nothing in 1917 to about 60,000 men in the fall of 1918. All that had to be accomplished and the organization had to be completed and perfected, and at the same time he had to co-operate and co-ordinate his institution with the French railways, which were run on an entirely different system from anything we know about in this country, manned by people who could not speak our language and very few of our men could speak theirs, and these entirely different organizations of men had to come in daily contact and had to co-ordinate without being able to understand each other. And in addition to that there was this inherent feeling on both sides, that each one of them knew the right way to do it, and at the same time the two methods were entirely different. As I look back on it that was a tremendous task General Atterbury had to accomplish and its successful accomplishment is a wonderful tribute to his genius for organizing a big institution and inspiring among all his personnel from top to bottom this enthusiasm for the accomplishment of what we were there for and the obliteration from their minds of those daily sources of friction that might well have spoiled the whole thing. His position was a unique one. Never such a thing had been done before in the world, and I doubt whether there is another man in the world who could have done it with the success and the smoothness that General Atterbury succeeded in doing it. To my mind that is the greatest thing any man could do, to get 50,000 men, under the trying conditions in which those men were, and have them so interested in the success of his enterprise that all the little things that look so big every day were pushed into the background and really accomplish the trick.

As his principal assistant at Tours first and later on as his representative in what we called the Advance Section, was Colonel McCrea. And those three men I think have earned the gratitude and appreciation of this country, and I think all of us who have grown up in the railroad business in this country should feel proud that this institution of ours was able to develop three men that could go over there and in face of almost insuperable difficulties build up a big organization, erect locomotives and cars, build tremendous terminal yards, storage depots ,and everything of that kind, out of nothing and all in practically a year and a quarter. And it was a tremendous and effective machine at the time the armistice put an end to it.

At Col. McCrea's suggestion I borrowed from him this small map of France which may help you to visualize more clearly the railroad situation so far as it was affected by the demand of the American army. The territory between the frontier and the sea was divided into what we called three Sections. the Advance Section, General Pershing's headquarters at Chaumont; the Intermediate back to the sea shore, and these Base Sections scattered along the sea shore and at Marseilles on the Mediterranean. The requirement General Pershing established was that at all times we should have in France 90 days' supplies for whatever number of men happened to be in France. The supplies were distributed among these three districts, Advance, Intermediate and Base sections. The gen-



Prepared under the direction of
Wm [illegible] Late Colonel [illegible] T C U S A
Deputy Director General Transportation [illegible]

eral scheme was this, that as ships came in to these different ports the essential thing was to unload the ships promptly, because the whole thing depended on ocean transportation. The cargo could be taken out of the ship more promptly than it could be hauled into the interior. For that reason these large Base Section storage depots were established only a few miles from the base and whatever could not be immediately transported into the interior was stored there and they became of tremendous magnitude before the armistice. Then as things could be transported away from the ports and were not immediately needed in the advance sections they were stored in these intermediate storage depots. Base section No. 6 (Marseilles) was not used until July, 1918, because the naval officers would not permit any transports to be taken into the Mediterranean until July on account of the submarines and then only under protest. Marseilles had the great advantage that it was only about 300 miles from Is-sur-tille, which was one of the principal storage depots and had two double track railroads serving it.

One of the first things that impressed me after my arrival over there was the difference in the relation between officers and employes in the army and on the railroads in civil life. There are two prominent features about that. One is of course that the men could not strike, and another, you could not discharge anybody. It worked both ways. It was interesting to see how these men, realizing that they were there for the course of the war, and they could not get away, realized the responsibility that was on them and put their shoulders to the wheel and did their very best in the face of very serious discomforts and difficulties of living. For instance an amy is based on units of constant size, 25, 50 or 100 men at least. In the railroad service you start out with an engine crew and train crew and there is nobody bossing them, and they had serious difficulty in getting food and lodging along the line. At first we were not able to give the soldiers any money. During the first stages we only gave them rations; starting them out for three or four days with only canned beef and crackers a man does not feel very well before he gets back. That was quite a serious difficulty at first. Afterwards we were able to do better. The regulations of the army were not devised for operating railroads, and the regulations did not fit the job. After a while we got that fixed up so that the men could be given money to buy food when they were away from headquarters. But before that was done there was very much grumbling. It interested me very much and gave me a sense of great admiration for the way in which these men took hold, realizing that they were up against a difficult situation, trying to help all they could instead of making all the trouble they could. They did it in a most creditable way.

There were some regiments of course that were selected soon after we entered the war that were all railroad men, but those regiments as a rule were assigned some specific task different from operating those trains in a miscellaneous way. We had a regiment assigned to locomotive work that did most creditable work. We had two big erecting shops, and they worked under tremendous pressure setting up locomotives, because we could not possibly have accomplished the amount of transportation that was necessary without the American locomotives that were sent over there. First they were sent over entirely knocked down and they had to be assembled, which was quite an undertaking. Later on we had ships built that would take a locomotive on its wheels without the tender, and that helped the situation very materially.

Another very striking thing to me was the difference between the French methods of operating and ours. In the first place they never knew what a despatcher was on a French railroad. Their lines were practically all double track, and even on a single track they have a system of running on schedules and with a regularity that was very successful. They had a station manager at every station whose jurisdiction within that station was absolute, not only for doing the business of the station but for the movement of trains into and out of the station. That seemed to us an impossible way of running a railroad, but the French people were able to do that for a great number of years and with the methods they had and the amount of business they had they did it very successfully. When the order came for mobilization on the 4th of August it moved with the regularity of clock work. They had for each of their principal lines a printed time card, not in the form our time cards are usually made, but more in the form of cards in the train despatcher's office for making train cards. They would have marches or schedules marked down, leaving a certain station at a certain time, with a line on the diagram for the whole length of the division. Those had been worked out in all detail years before the war started, thinking some day they would have this war, and with the object of having a sufficient number of trains to move the soldiers that originated on that railroad. And they tell me they went with tremendous regularity. They were able to accomplish it, as I look at the situation, largely because of the French capacity for anticipating things in detail in advance to an extent we do not dream of in this country, so that over there they never have an emergency. The whole thing went just the way they had planned it.

You could not imagine us doing anything like that in this country. When we began to mobilize an army here we did not know what state they were coming from, much less the station . We had to have a flexible system to meet the emergency. Up to the time we arrived with our different ways of doing things this scheme of theirs worked admirably. After we got over there we began to get into difficulties. In the early summer of 1918 we were using the line from St. Nazaire up to Tours and up to Is-sur-Tille very extensively, also the line from Bordeaux and the line from LaRochelle. At St. Nazaire we were unloading ten or twelve ships all the time. We had three of the schedules, or marches as they call them. Three times during the 24 hours we could start an American train if we could get an engine and train. If we could not get it we had to wait until the next march came. That did not look very well and it did not work very well either. We were using a great many French locomotives and crews hauling our American stuff and it was pretty difficult to get the cars loaded and ready just exactly at the time of this marche, and if it was fifteen minutes late it could not go until the next one. And if some one wanted something in between times, it could not go until the time arrived. As the business increased and as our engine and train crews increased it got a good deal more difficult. The engines and crews were ours and directed by our officers. and at the same time the railroads belonged to the French operated by their chef du gare and they were in business not only militarily but commercially and we had to abide by their regulations. It caused a good many misunderstandings, particularly because we could not get each other's point of view. One of the proposals made by General Atterbury, which after a good deal of discussion was accepted by the French railroad people, was the putting of despatchers on some of these principal lines. The one that was most congested of all was this one from St. Nazaire up through Tours to Is-sur-Tille. Along in the fall of 1918 it was not unusual to see a train in every block along that railroad of some 400 miles, and none could move until the block ahead was cleared. We thought if there could be some supervision such as a despatcher exercises under which a train would not be started out until it had a show of getting into the next terminal it would increase the capacity of the railroad very materially. Finally the French railroad people agreed to the installation of the American despatching system on that line, but it was hardly in operation when the armistice came. But it would have been absolutely necessary to have some plan of that sort because under the French plan of working without despatchers we had that line right up to the limit of its capacity, and at the time of the armistice everybody thought the war was going to continue until the next summer and we had planned on doing just about twice as much in the way of transportation by the following may as we were doing in October, 1918.

Another thing that the French people have never done is to get as much work out of the facilities and locomotives as we do. Every locomotive engineer has his own engine and if he is not able to go the engine does not go.

Another thing that impressed all of us as being curious in the French way of running railroads was that they never had anything at all corresponding to our system of car reports. It was like putting a letter in the postoffice and that is all you know about it until it gets to the man to whom it is addressed. It is surprising with their own business how well it worked out. It was very seldom that any of their freight was delayed materially or misrouted. They handled them entirely by labels pasted on the sides of the cars. I attribute their success very largely to the superior quality of work they get from their ordinary men compared with the work our men give. It seemed to be bred into those fellows to do a simple mechanical job with care enough so they did not make mistakes. It is not bred into us to do that. It is bred the other way, and we had to organize a car service department because the mixture of the two systems on the French railroads seemed to destroy to a certain extent their accuracy and it left us perfectly at sea. They did not keep a record of their car mileage or locomotive mileage as we do. At the same time when they had just themselves to deal with they accomplished most excellent results. Their final results of operating railroads were as good if not better than ours, but they did not do it with the economy we do and they did not utilize their facilities as we do. They have this fundamental difference, that the price of labor is so much less than it is with us that they can afford to employ a good many men to do a thing while we could afford to spend a very large amount of money to eliminate a man. The consequence was that they were doing a great deal of work by hand in a very combersome and expensive way, which they could not afford ,if they had to pay the wages we have to pay. That was very noticeable in the harbors. They have some very good cranes at some of their harbors but only at the navy yards and ship building plants where they have to handle heavy articles that could not be handled by hand. While France has been a big importer of coal for centuries practically all the coal that was brought into France from abroad was unloaded by hand. It is all unloaded from cars by hand. There wasn't a hopper car in the country and they don't know what a refrigerator car is. They have no refrigerating plants. The whole scheme of transportation is on a fundamentally different basis from ours and it is that which made it particularly difficult for us to co-ordinate ours with theirs.

Another feature of the rail transportation problem over there that was very interesting was getting the supplies from these depots and regulating stations, such as Is-sur-Tille, to the troops in the front lines. That was something that just had to be done. It was more important than passenger trains. The men at the front had no surplus supplies and it was absolutely essential that the food and ammunition for those different units at the front should be delivered with regularity. They could not take two days' supplies today and go without tomorrow. Every unit in the combat troops had to get a supply of everything, fresh meat, vegetables, milk, bread, etc., and ammunition. That had to be put in a group by itself and it had to arrive at the rail head where the trucks of each detachment took their stuff out of the cars at a regular time. And that was accomplished with almost infallibble regularity. The distances were not very long but the time was limited. These cars were loaded at the regulating stations during the day and must be at these unloading points at some definite time and there was no leeway as to time. These movements were sometimes interfered with by wrecks and artillery operations and things of that sort, but it was the one thing that had to be done, and it was done with remarkable success.

Then beyond the regulating stations we had a complicated system of narrow gauge railroads, about 2-foot gauge, that were not managed by the transportation corps. The locomotives were very small, with saddle tanks, and particularly in handling ammunition they were very much better than motor trucks. For even a five-ton motor truck does not handle ammunition to last a 3-inch gun very long. And they were also much less liable to serious interruption from shell fire than highways. If a shell hit a section of track the damage done could be repaired very much more rapidly than it could on a highway. On a paved road it was a matter of several hours to repair it. These narrow gauge lines were used very much more extensively by the Germans than they were by us. They had those narrow gauge railroads built in as permanent a way as we would build a main line railroad, ballasted with rock, and they used them almost exclusively for supplies for the forces in the trenches. Ours were used in a rather more temporary way. The sections of track were made in this country, of about 15 or 20-pound rail, with small steel ties bolted together; and three or four men could carry a section of track and it could be laid on very uneven surface, and the maintenance in condition to operate over was not as difficult as it is sometimes to keep the highways in shape.

After the armistice the story was a different one, of course, so far as we were concerned. The dotted lines running from the heavy black line where the final front was between the Germans and the Allied armies, at the time of the armistice were railroad lines running to the American bridge head at Coblentz and the French bridge head at Mayence on the Rhine. We never extended the operation of the American locomotives or personnel into German territory after the armistice. We found that it was not necessary. The Germans seemed to have considered their railroad service more as a part of the army than the French did. The French drafted their men from the railroad service just as they did from a store or factory. When those men were taken away their places were filled with old men or boys or women. In Germany they seemed to have preserved the personnel of their railroad organization almost intact. So we found no necessity for supplementing the Germans with any of our men or locomotives, but we did have to send cars for the movement of our supplies. We had about 500,000 men at Coblentz in the winter after the armistice and all the transportation over the German railroads was performed by the German personnel and German motive power.

Another thing that may be of interest. There was always more or less talk of the amount of railroad built by our forces in France. The general apprehension about that is erroneous. The only real main line railroad that we built is shown by that little dotted line near Nevers. We built about seven miles across there with double track with a steel bridge over the Poire River, a very heavy piece of work, but it seemed advisable because of the relief it gave to the through movement along this principal line of communication and kept it out of the Nevers terminal. That is the only main line we built, practically. But the constructions at terminals and sidings ran into a tremendous amount of work. We had 200 miles of track in one terminal alone and I would not dare say how many acres of store houses. There was no necessity, and we did not have time either, to build a main line railroad because if the war had gone on into another year I am confident that with the introduction of our American system of handling trains by train despatchers we would have been able to transport all the supplies that would be needed with all of the lines including those from Marseilles that were used but very slightly because the armistice came only a few months after we began sending ships to Marseilles.

One feature that I think we can look back to with most gratification is the spirit with which our men went into this tremendous undertaking, in view of all the difficulties and handicaps that were incident to their working with the French. If we could have taken over one of their railroads and ran it as our own it would have been a simpler problem. But that could not be done because the commercial business had to be done by the Frenchmen and the French military necessities while not as great as ours on these particular lines, still were of importance. The introduction of our system of despatching would have enabled us to carry the load that was set out for the next summer if the armistice had not intervened. But the spirit in which our men went into the thing interested me more than any other one feature of it. The enthusiasm and the cheerfulness with which they stood up under hardships and difficulties that were entailed in operating the roads in the way we had to do it made a very warm place in my heart for the men.

One thing I want to speak of that has not to do particularly with transportation in France, but is a question of considerable consequence to our country, and one on which a man who has been in service over seas is perhaps privileged to express himself and his opinion freely, is this movement to grant a bonus to all the soldiers that were in our army. It seems to me there are three points of view from which that idea may be either defended or opposed (1) on the basis of expediency; (2) on the basis of precedent; (3) on the basis of principle. Up to very recently there seemed to be very little opposition to the granting of a bonus, but the advocates of it have said very little about the expediency of saddling upon our country at this time a very large expenditure that will be involved in granting a bonus to every one who was enlisted in the army whether he served overseas or not. The wisdom of any move of that sort I believe to be determined somewhat by expediency, but I do not think that is a very important feature. If it were a right thing to do we could raise the money in some way to do it. Another point of view is that of precedent. The advocates of the bonus do not say much about the precedent feature of it. But it seems to me that in a world where we should not be guided entirely by precedent, it is at least valuable in helping us to choose the right course to pursue. Centuries ago in the times of Alexander and Xerxes and Hannibal and Caesar those men who went out and conducted a successful campaign against the barbarians were permitted to loot the countries they conquered, bring their inhabitants home and make slaves of them, but they did not come back home and loot their own people and ask their own people to give them what they had been able to save. It seems to me that a similar principle applied at the time of our Civil War. The men who served in the Civil War certainly submitted to more hardships than the men who served in this last war in our army. Those who were killed or injured were provided for in one way or another. But by no means did one consider, so far as I have heard, giving everybody who was in our Civil War army a bonus or a pension or a graduated adjustment of pay or whatever you may call it. Fifteen years after the Civil War was over there were less than 150,000 soldiers drawing pensions and a little over 100,000 widows drawing pensions. And we had in our armies in the Civil War about half as many men as we had in the last war. Fifteen years afterwards less than 150.000, 10 per cent, of the soldiers were being pensioned and they were being pensioned because of injuries or sickness, they were not being handed out a gratuity. It seems to me those two reasons make it debatable, at least, whether a bonus should be granted to all of these men.

The matter of principle is the one that should govern our Congress and our government and our country in this regard. Among all the men I have talked with on the other side I never heard the question mentioned while the soldiers were in France. I have talked with fellows who had lost legs and had been gassed and had been incapacitated in all sorts of ways, and I never heard the question mentioned. I am one of those who feel that this country can not do too much for those who were wounded or who are sick or whose families were left in need. The country has been a little slow in getting that machinery going but the intent has always been to take generous care of every one who suffered from illness or casualty due to his service in the army. And now that the machinery is working so well, we are spending about $500,000,000 a year taking care of men who were injured, and no one would criticise that expenditure. If it took twice or five times that much, this country can not spend too much money to take the best of care of everybody who went over there and was killed or wounded or his health shattered. But to hand out to some of those fellows who never went overseas, even, but who went into camp and were well fed and well clothed and benefited by training, a small sum of money they know in their hearts is not due them, is debasing to their character and an affront to their patriotism. Do you suppose any one would have gone into the service more freely if he had known that he was going to get $500 or $1,000 as a gratuity? They could not. You never saw a big bunch of young fellows so keen to do what was set before them as those boys in France. You could not buy that sort of thing, and it is an insult to offer them a little money for doing what they went to do. If we start this scheme of paying these men simply because they went over and did the highest duty that was in front of them we are striking a blow at the foundation of the greatness of this country. Those boys all came back unhurt. They did not suffer as thousands of men did in Western Pennsylvania years ago in hewing the country out of the wilderness or crossing the Rocky Mountains in winning the west. They did it from a spirit of loyalty, to make this country a race of self-supporting, vigorous men. And I am glad to see our new Senator from Pennsylvania throwing his influence against this idea of granting a bonus to men that know in the back of their heads that they do not deserve it. I thank you.

PRESIDENT: If anyone wishes to ask any questions, Colonel Nutt has kindly consented to answer them as far as he can. If not I will ask Mr. Gilg to favor us with another selection on the piano.

Another selection was then rendered by Mr. Gilg of which the Club showed its appreciation by applause.

Upon motion, a rising vote of thanks was carried out by the Club in appreciation of the talk presented by Col. Nutt.

There being no further business, upon motion the meeting adjourned.

J. D. CONWAY, Secretary.

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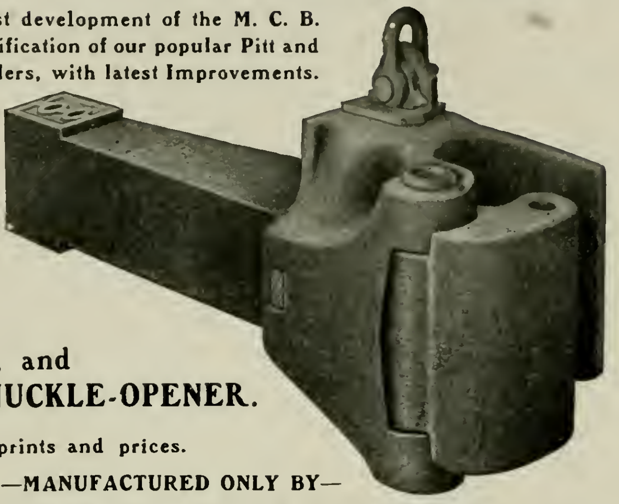

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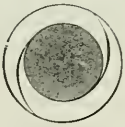

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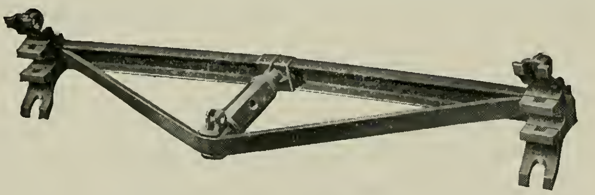

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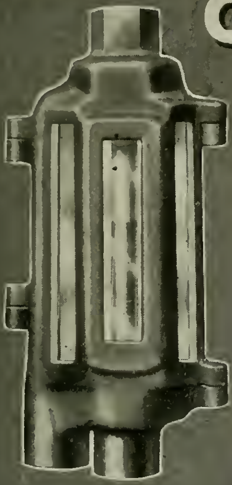

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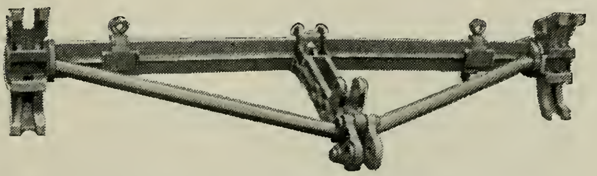

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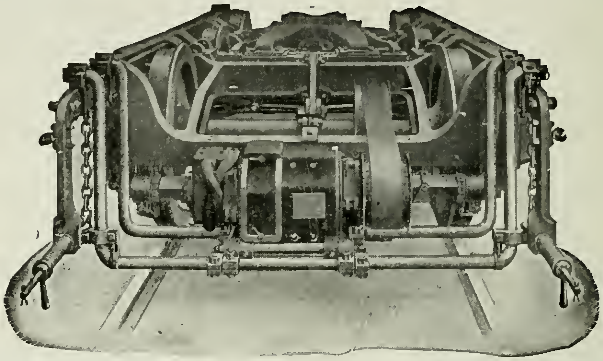

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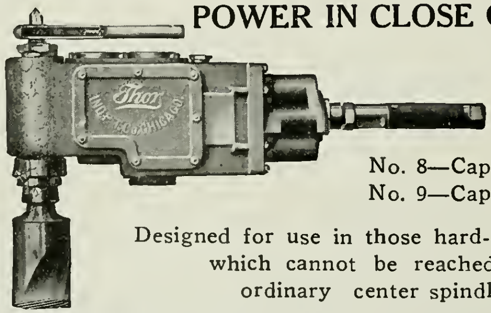

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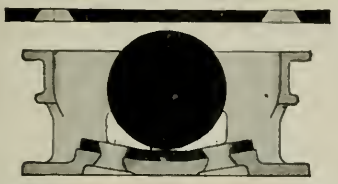

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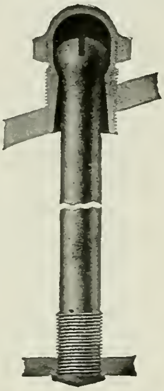

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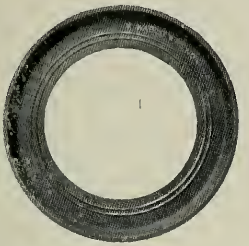

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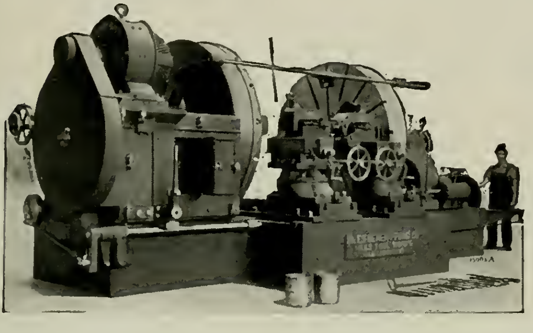

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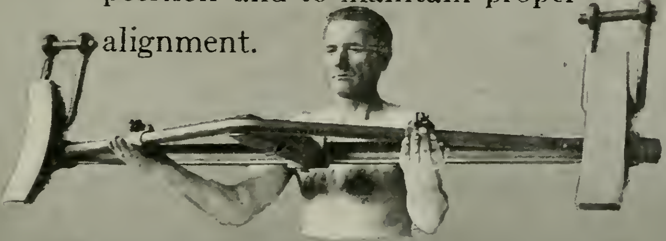

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H. H. MAXFIELD	November, 1919,	to October, 1920
F. J. LANAHAN	November, 1920,	to October, 1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
MARCH 23, 1922.

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock P. M., Vice-President D. F. Crawford in the chair.

The following gentlemen registered.

MEMBERS

Adams, Lou
Adams, W. A.
Anderson, A. E.
Babcock, F. H.
Blakley, T. M.
Ross, R. E.
Bradley, W. C.
Brewer, Geo. D.
Brower, J. E.
Carbis, A. J.
Cartwright, Wm. E.
Ceska, Geo. D.
Christy, F. X.
Connell, Wm. H., Jr.
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Crenner, J. A.
Cunninghamm, H. R.
Cunningham, J. L.
Cunningham, R. I.
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Daniel, J. V.
DeMoske, C. E.
Devans, E. J.
Dickson, K. B.
Dietrich, O. M.
Donovan, Edw. J.
Durkin, Jas. E.
Edwards, C. H.
Ellis, C. B.
Ellis, H. T.
Emery, E.
Fair, Chas.
Farrell, Henry E.
Freshwater, F. H.
Fults, J. H.
Galinis, J. W.
Gammiere, E. J.
Gibson, G. A.
Goda, P. H.
Graham, John A.
Grieve, W. F.
Gross, Chas.
Hale, Chas. E.
Hansen, Wm. C.
Harger, M. L.
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Haynes, J. E.
Henry, C. L.
Hindman, S. M.
Hoffman, C. T.
Hood, J. M.
Howe, C. A.
Howe, D. M.
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Hussong, A. C., Jr.
Jungbluth, Adolph
Kaiser, R.
Kelly, Harry S.
Kelly, Leo J.
Kindle, W. F.
King, J. W., Jr.
Kirkpatrick, H. F.
Kranse, Harry A.
Kummer, Jos. H.
Lake, Albert H.
Lanahan, J. S.
Lanning, J. Frank
Lauderbaugh, H. B.
Laughner, C. L.
Laurent, G. F.
Long, H. P.
Matchett, H. K.

Meeker, H. B.
Millar, C. W.
Miller, G. M.
Milliken, J.
Mitchell, John H.
Montgomery, J. L.
Moore, D. O.
Moyer, Oscar G. A.
Murphy, W. J.
McCloskey, J. C.
McDermitt, E. E.
McDowell, D. W.
McGregor, D. C.
McKee, S. Frank
McMurray, C. H.
McNulty, F. M.
O'Brien, M. J.
Ogden, Geo. D.
Olsson, N. A.
Orchard, Chas.
Partington, J. A.
Rabold, W. E.
Reeve, Geo.
Reynolds, D. E.
Rhoads, G. A.
Rick, R. C.
Rimmel, C. C.
Ritts, Wm. H.
Robinson, R. S.
Rogers, John W.
Ryan, D. W.
Saltic, Thos.
Sattley, E. C.
Saxer, Harry
Searles, E. J.
Severn, A. B.
Shannon, David E.
Smith, W. L.
Smythe, W. C.
Speir, Wm. S.
Stark, F. H.
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The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership.

Anderson, G. S., Foreman, Pennsylvania System, Box 19, Pennsylvania Station, Pittsburgh, Pa. Recommended by C. G. Skuce.

Braun, Frederick R., Gang Foreman, Power Plant, Pennsylvania System, 132 Julius Street, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Brill, Bernard A., Stockman, Pennsylvania System, 2122 East Street, N. S., Pittsburgh, Pa. Recommended by C. B. Gray.

Brown, E. W., Loco. Engr., P. & L. E. R. R., 604 Knox Avenue, Monessen, Pa.. Recommended by S. A. Damore.

Corns, A, Power Clerk, Western Pennsylvania Division, Pennsylvania System, 206 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Daley, John, Conductor, P. C. & Y. Ry. Co., McKees Rocks, Pa. Recommended by E. L. Harney.

Ellis, A. R., Gen. Mgr., Pittsburgh Testing Laboratory, P. O. Box 1115, Pittsburgh, Pa. Recommended by J. Milliken.

Hartshorn, E. F., Gang Fore., Pennsylvania System, 7026½ Bennett Street, Pittsburgh, Pa. Recommended by C. G. Skuce.

Hays, J. Leo., R. F. of E., P. C. & Y. Ry. Co., 200 Mary St., Carnegie, Pa. Recommended by E. L. Harney

Jenny, G. W., Gang Fore., Pennsylvania System, 1152 Brownsville Road, Carrick, Pa. Recommended by C. G. Skuce.

Jones, John H., Gang Fore., Pennsylvania System, 308 Carver Street, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Lauderbaugh, Harve B., Salesman, Pittsburgh Testing Laboratory, 7th and Bedford Avenues, Pittsburgh, Pa. Recommended by J. Milliken.

Miser, C. H., Cashier, P. C. & Y. Ry., R. F. D. No. 1, Coraopolis, Pa. Recommended by E. L. Harney.

Nall, R M., Prin. Asst. Engr., P. & W. Va. Ry., 439 Wabash Bldg., Pittsburgh Pa. Recommended by R. L. Barrett.

Newman, John F., Storekeeper, Pennsylvania System, 6555 Shetland Avenue, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Nutt, Col. H. C., Pres. & Gen. Mgr., Monongahela Railway Co., Century Bldg., Pittsburgh, Pa. Recommended by J. D. Conway.

Oakley, Philip A., Gang Fore., Pennsylvania System, 748 Napoleon Street, Johnstown, Pa. Recommended by C. B. Gray.

Smith, R. H., Chief of Tariff Bureau, Pennsylvania System, 802 Chamber of Commerce Bldg., Pittsburgh, Pa. Recommended by R. C. Kegel.

Tozer, R. J., Gen. Agt., Northern Pacific Rwy., 518 Park Bldg., Pittsburgh, Pa. Recommended by J. M. Morris.

Wiesemann, Harry G., Gang Fore., Pennsylvania System, 750 Franklin Street, Johnstown, Pa. Recommended by J. L. Cunningham.

VICE-PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

Announcement was made of the death of Mr. J. McF. Easton, Superintendent of Machinery and Equipment, Pittsburgh Spring & Steel Company, died June 11, 1921.

VICE-PRESIDENT: Appropriate memorial will appear in the Official Proceedings of the Club.

There being no further business, Dr. John S. Unger, Manager Central Research Bureau, Carnegie Steel Company presented the paper of the evening entitled:

"IRON, THE MOST IMPORTANT METAL IN THE WORLD."

By Dr. John S. Unger

Early History and Discovery

The discovery and use of Iron in one of its common forms as Wrought Iron or Steel is shrouded in remote antiquity.

It is probable that the four common metals, as Iron, Copper, Lead and Tin, were produced by man very soon after he discovered and began to use fire. The rarer and more valuable metals; such as gold and silver, occurring in the metallic state and not requiring a fire for their reduction, were probably known at an earlier date. In the Bible in the second Chapter of Genesis mention is made of Gold, while Iron is not mentioned until we reach the fourth chapter.

Some writers are unwilling to admit Iron was made by primitive man. In an article before the British Iron and Steel Institute, the author points out that Iron is of modern origin and the early supplies of iron were obtained from meteorites.

This author calls attention to the many legends of the ancients, claiming Iron came from heaven, and attempts to show that meteorites falling from the sky with a rush of fire and a loud noise would so impress primitive man as to cause him to believe it was an act of some God they worshipped, who lived in the sky.

He further tries to show the peculiar markings, figures, or striations on the famed Damascus sword blades were simply the Widmanstatten figures observed in all meteorites, caused by the difference in appearance of the two metals, nickel and iron, of which they are composed.

According to this authority, Iron used before 1200 B. C. was obtained from these sources, meteorites, by chance production of a camp fire, a flash of lightning, or a forest fire. However, we have at Delhi in India a wrought iron column, which from the inscription cut into the metal, archaeologists have determined its age to date from 900 B. C.

As an example of early iron it is remarkable, being a piece which is considered quite large even at the present day. This column, which is almost 3000 years old, is 24 feet long, 21 feet above the foundation, 16 inches in diameter and weighs over 13,000 pounds. This column is in a fair state of preservation, showing the Iron Workers of India possessed great skill in making iron in large masses and forging it into shape. Such a feat is envied by many of the modern iron manufacturers of today.

Since it is very difficult to prove early traditions or legends, I too have a story to tell, which I believe is not alone possible, but probable. This story is based on about the same evidence that most of the writers on this subject have, which is a guess at probabilities. I believe I should be allowed an equal license and will tell you my story.

When Adam and Eve were expelled from the Garden of Eden, they and their numerous family, the older boys being Cain and Abel, journeyed along the Euphrates river, pitching their camps where fuel, food and water were plentiful. They would remain in a certain locality for months, or even years at a time, depending on the abundance of game, fish, fruit, or any grass, grain or vegetables which Cain, who was a farmer, could raise.

Having camped for many months along the river where the soil contained iron or was of an iron ore character, and having kept a large camp fire going at one point for a long time, exhausting the adjacent wood supply used as a fuel, Adam decided it was time to move to a new locality. Moving those days being a simple matter.

The next morning after breakfast as Adam shouldered his pack, Eve following along behind him loaded with primitive cooking utensils, he stopped and called back to his sons, Cain and Abel, and to his grandsons to be sure and put out the fire before they left the camp. The grandsons commenced carrying water to put out the fire and boy like stirred up the coals with sticks, when one of Cain's sons, Enoch, found a heavy lump among the ashes which he thought was a stone, but was surprised to find it was of irregular shape and very heavy. His curiosity was aroused and he raked it out of the ashes and carried it on the end of his stick to the river, cooling it off in order to examine it. He was impressed by its weight and by the fact he could not break it when he threw it forcibly on the rocks as was his custom in breaking small stones. He also found it to be very hard, so hard he could scratch the rock with a sharp corner of it.

He showed it to his father Cain, who with the superior manner of most fathers, promptly pronounced it a stone of some kind, but on attempting to break it open he was unable to do so. Cain then put it into the fire, and when it became red hot, pounded it between two stones, hoping to break it, but to his surprise it was malleable and pounded out into a wedge shaped piece somewhat like a rough axe. After pounding and heating it a few times, he decided it acted very differently from a stone. He then cooled it in water for further examination. When cold it was a hard, unbreakable material stronger than a rock. He believed it might make a good axe for cutting wood, and after tying a piece of wood to it for a handle he used it as an axe, it proving to be the best axe he had ever owned.

In this story we have all the essentials of the manufacture of steel; an Iron Ore and a hot, prolonged fire, producing a regulus of steel. This steel was reheated and forged, afterwards quenched in water to cool it. Here is the birth of the metal Iron, showing its reduction by fuel, the subsequent forging operation and finally the heat treatment, combining every essential of the modern steel industry.

Common Kinds of Iron

The metal iron exists in the arts in three common varieties, Cast Iron, Wrought Iron and Steel. Absolutely chemically pure iron is unknown, as it is practically impossible to produce such material. Iron is usually found combined with many other elements, the principal and the one affecting its properties most strongly being Carbon. When Iron contains very little Carbon it is soft and ductile and can be easily bent and welded and is called Wrought Iron. Iron containing one ounce Carbon to 100 lbs. of Iron is a soft, ductile material, almost like wrought iron, while that containing from 1 to 1¼ lbs. is hard steel such as can be tempered and made into springs, files or knives. When the Carbon is raised to from 2½ to 4 lbs. for every 100 lbs. of Iron, the metal can not be forged, but must be cast in a mold from a molten condition to obtain the desired shape. This variety is called Cast Iron, which is the raw material used in the Iron Foundries.

Amount of Iron Produced and the Methods Used

To make a pound of cast iron, which is the starting point for the making of either wrought iron or steel, we require in present day practice 2 lbs. of Iron Ore, 1 lb. of coke, ½ lb. of limestone and 4½ lbs. or 60 cubic feet of air. When these materials are properly mixed and put through a Blast Furnace we obtain one pound of Pig Iron, ½ pound of slag and 6½ pounds of gases.

Cast or Pig Iron is converted into Wrought Iron or Steel by removing the excess Carbon it contains. This is accomplished in the Puddling Furnace when making Wrought Iron, and by the Bessemer, Open Hearth or Electric Furnace Processes when making steels. The Crucible Process of steel making is simply a melting down of very pure Wrought Iron or Low Carbon steel in a crucible and adding the necessary materials to purify and bring the product to the quality desired.

The production of steel in the United States has grown enormously since the beginning of the present century. Thirteen million tons were made in 1901, 26 millions tons in 1910 32 millions tons in 1915 and 35 millions tons were made made during 1920.

The production of steel for each inhabitant of the United States shows how we have grown as a steel producing and consuming nation. In 1880 we made 54 lbs. for each man, woman or child in the country; in 1890, 153 pounds; in 1900, 398 pounds; in 1910, 640 pounds; and in 1920, about 713 pounds, or at the rate of 62 tons for every minute in the entire year. Roughly it may be said the United States makes more than one-half of the entire steel made in the whole world.

Changes in Method of Manufacture

The methods used to make steel are changing. This is principally brought about by a change in the quality of the ores. In former years ores could be obtained low in Phosphorous from which steel could be made by the Bessemer Process. In 1900 three-fourths of all the steel made was Bessemer. As the purer ores were exhausted a different method, the Basic Open Hearth Process which permits of purification of the steel, became common, and now three-fourths of all steel made is Open Hearth steel.

THE INFLUENCE OF VARIOUS ELEMENTS OR THE AGE OF ALLOY STEELS

In addition to the ordinary elements found in steel, other elements are purposely added to give certain qualities.

If but one-quarter of a pound of copper is added to 100 pounds of molten steel, the finished steel product will not rust nearly so fast as steel without Copper.

When 12 pounds of Manganese are added to 88 pounds of steel the resulting alloy is very hard and resistant to wear and in addition very tough. Such steel is called Manganese steel and is used in all frogs, switches and crossings of your street car tracks, in many of the safes or vaults used in your banks, and for many other purposes for which a hard tough material is desirable.

When Nickel up to 5% is added to steel it increases the strength without seriously affecting the toughness. Such Nickel steel is used where great strength and a reasonable toughness is necessary, as in guns, armor and large shafts. If the Nickel be increased to 36%, an alloy called Invar is obtained, which has the least expansion and contraction for each degree of heat at normal atmospheric temperatures of any metal known. Such material is used in making clock pendulums, measures, tape lines and other scientific instruments in which the least possible change in length as the temperature changes is essential. If the Nickel is increased to 46%, an alloy Dilvar is obtained which has the same expansion as glass, and is used for the wire netting in your plate glass windows, or at the base of your electric lamp bulbs to which the filaments are attached to avoid cracking.

When 3 to 4 per cent of Silicon, an element only one-fourth as heavy as Iron, is added to steel it produces a very valuable alloy used in the manufacture of steels having certain magnetic properties, and is employed in electric motors, transformers and in your telephone.

If 12% of Silicon is added to Cast Iron and the metal is cast into pot or kettle shaped vessels, strong acids or other corrosive liquors may be concentrated or boiled down in such vessels without attacking and destroying them.

Tungsten is a metal 2¼ times heavier than Iron. The filament in the electric lamps over this table are of Tungsten, which is used because it does not melt at the very high temperatures within the lamp. When this metal is added to steel at the rate of 4 pounds to 100 lbs. of steel, it makes a steel whics can be made into a stronger permanent magnet than any other material. If added to tool steel in quantities varying from 8 to 18%, together with about 4% of Chromium, it produces a high speed tool steel which after proper hardening will do from five to twenty-five times as much cutting as plain, ordinary tool steel, and has revolutionized machine tool construction within the last fifteen years.

Physical Properties of Iron

An average piece of Cast Iron 1 inch square will break when a load of 20,000 lbs. is applied. A similar piece of Wrought Iron has about twice this strength, or 40,000 pounds. One square inch of soft steel will break at 50,000 lbs. By adding Carbon and other elements and heating and quenching the steel, its strength can be raised to over 300,000 lbs., or a 1-in. square piece of such steel is as strong as a bar of soft steel 6-ins. wide by 1-in. thick.

Iron is the most highly magnetic metal we have any knowledge of. If Iron did not have this property, you would not have your present street cars, your electric railroad, your telephone, your electric light, the fan in your office, and many other of the commonest necessities of life.

Soms Uses of the Waste Products

In making a ton of Pig Iron, about one-half ton of slag and 6½ tons of gases are produced. For many years and to quite an extent at this time, the slag was thrown away. It was not possible to find any use for it other than for filling in low ground around an Iron Works.

At the present time a large quantity of such slag is granulated by being run into a pit filled with water, or by being broken up and cooled by a jet of water under high pressure, producing a soft pumice like material which is pulverized and used in the manufacture of Portland Cement and in making Slag-Lime bricks.

A large proportion of this slag is hauled away from the Blast Furnace in a molten condition in special ladle cars and poured over a slag-bank, where it cools and weathers. It is afterwards taken out by a steam shovel, crushed and screened, and later used as a substitute for stone in railroad ballast, road making material, aggregate in concrete, and as a substitute for fine gravel in roofing materials.

The gases from a Blast Furnace are saved by burning them under boilers for steam making purposes, for heating the air blown into the furnace, and in large gas engines to furnish the power required to blow the furnace or to produce the electric current for operating the electric machinery in a steel works.

Most Iron Ores found in the southern part of the United States are high in Phosphorus. In making steel from such ores, a limey slag is obtained containing about 18% of Phosphoric Acid, a very valuable constituent found in fertilizers. This slag is cooled, pulverized and sold to the farmers as a substitute for Bone Phosphate, Super-phosphate and other artificial fertilizers.

When coke is made in the modern By-Product oven, all the wastes or by-products are saved. In the older bee-hive coke ovens, no attempts were made to save anything but the coke. This loss was enormous, as it was estimated that in 1913 the loss of by-products in bee-hive coke ovens amounted to over seventy millions of dollars.

Every ton of coal coked in the new By-Product coke ovens gives a 10% higher yield of coke than the old bee-hive ovens, and in addition, it furnishes 5,000 cu. ft. of gas for fuel, 22 lbs. of Ammonium Sulphate, an important fertilizer containing Nitrogen, 7 gallons of tar used for fuel, roofing and road-making purposes, 2 gallons of Benzol, a liquid much like gasoline, and many other organic compounds from which explosives, medicines, dyes and scents are made.

NEW USES FOR STEEL

Steel is rapidly replacing wood, stone and bricks for many purposes. Your sky-scrapers, large bridges, large ocean steam-ships, the Penama Canal locks, and modern war materials are only made possible by the use of steel. Without steel they could not exist.

Wood is becoming scarcer and more expensive, and the principal substitute is steel. Before many years the wooden railroad tie will disappear and be replaced by the steel tie. At this time this is true in some European countries. Steel furniture, steel packing boxes, steel telephones and telegraph poles and many other articles will replace wood.

Very few railroad cars are now made of wood. Your street cars and automobiles are made of steel. These new uses for steel, together with the increase in size and weight of many articles now made of iron or steel, and the increased use of steel in such countries as India or China, who use very little steel in proportion to their population, makes the question of the future supply a serious problem.

33½ per cent. of the world's population or 500 million people consume annually over 70 million tons of steel, or at the rate of one ton for every six people. When the entire world's population of 1½ Billions consume steel at the same rate which must be the result as civilization advances, the world must produce ½ Million tons of steel every day. This enormous consumption will soon exhaust the rich iron ore beds of Central Europe, Norway, Russia, China, India, the U. S., and Cuba and Chili. Beds of iron ore now considered entirely too poor to be worked will be worked before the middle of this century. None of the other elements can really be considered a substitute for Iron. The progress of civilization, in fact the future history of the World, will largely depend on the ability of posterity to find an adequate supply of iron ore and of fuel, from which Iron, the most important metal in the world, can be made.

VICE-PRESIDENT: I did not think Dr. Unger was going to look at his watch so closely. I think we would all like to hear some more of that wonderful address he has given us. I wonder if he would not like to answer some questions? Has anybody any questions they would like to ask the Doctor?

MEMBER: Is there a grain in tool steel?

DR. J. S. UNGER: There is a grain or crystalline structure in almost every variety of steel. If you break a piece of very fibrous iron you will get fibre. I might further tell you, the higher carbon the finer the grain.

MEMBER: Would you suggest the use of copper in the railroad car?

DR. J. S. UNGER: Yes. Cars of copper steel have been in service since 1914, giving good results. I am of the opinion that the introduction of .15 to .30 of one per cent copper to steel plates will increase the resistance of that car to corrosion and erosion on an average of at least two and one-half times.

MEMBER: How about this steel car to be made of part copper steel. Can it be hardened so it will not wrinkle?

DR. J. S. UNGER: It is just as soft or hard as the ordinary car.

MEMBER: Would copper steel in a boiler plate change the tensile strength?

DR. J. S. UNGER: Slightly; about 1000 pounds. One-fourth of per cent will make it about 1000 pounds stronger on an average.

MEMBER: In general, what is the highest percentage of carbon used in the steel rail of today?

DR. J. S. UNGER: Very rarely do we have steel rails containing over 90 carbon. The average will run 75 carbon. Different railroads specify different carbon contents. It will run from 60 to 90 carbon.

MEMBER: When Fordney was here, he said only 5 per cent of our production was export. If that is true, why did we depend so much on the foreign market.

DR. J. S. UNGER: My recollection is he stated our foreign market was so small that we need not consider it.

MEMBER: In putting copper into molten steel, is it easily mixed?

DR. J. S. UNGER: Easiest thing in the world. It mixes easily and stays put.

Upon motion, a rising vote of thanks was extended the speaker for his excellent address.

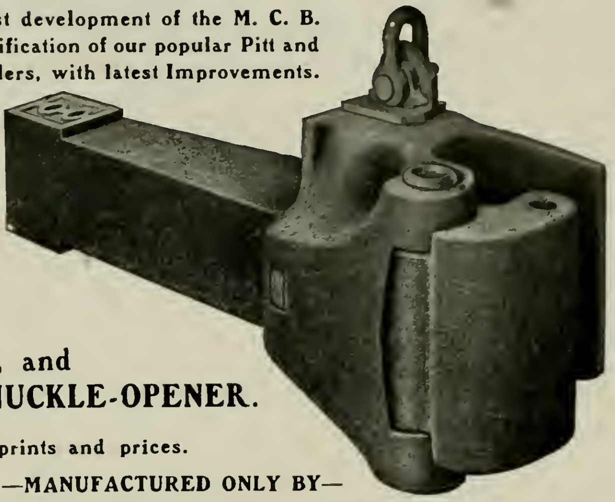
There being no further business, upon motion, meeting adjourned.

J. D. CONWAY, Secretary.

In Memoriam

J. McF. EASTON

Died June 11th, 1921



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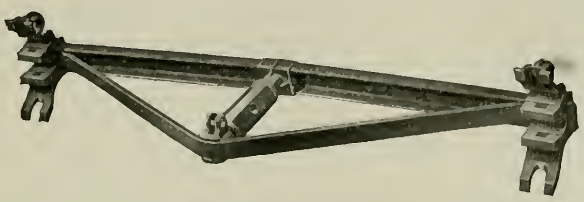

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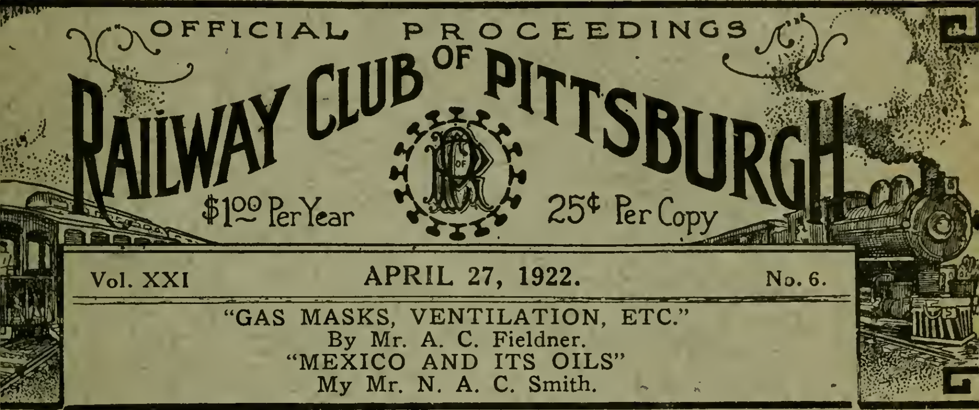

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My Mr. N. A. C. Smith.

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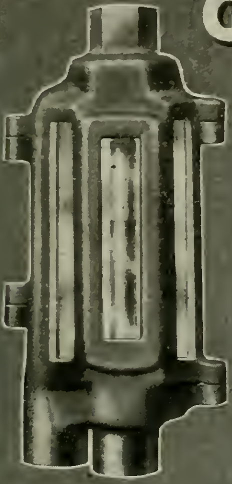

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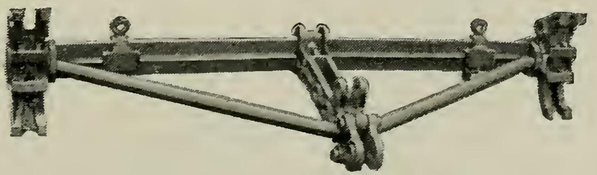

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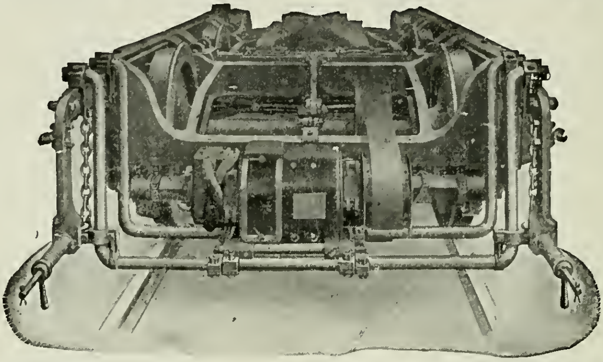

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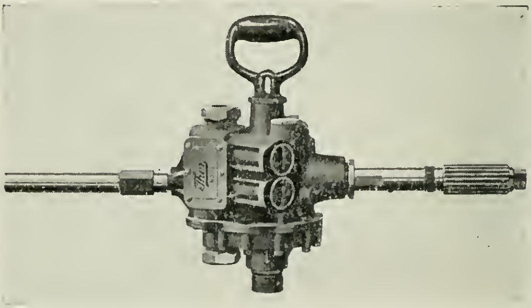

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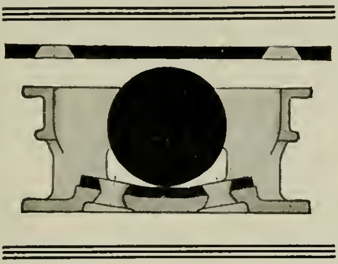

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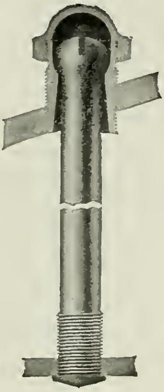

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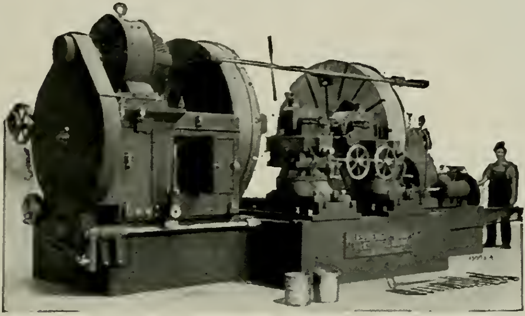

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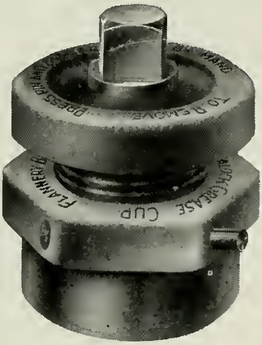

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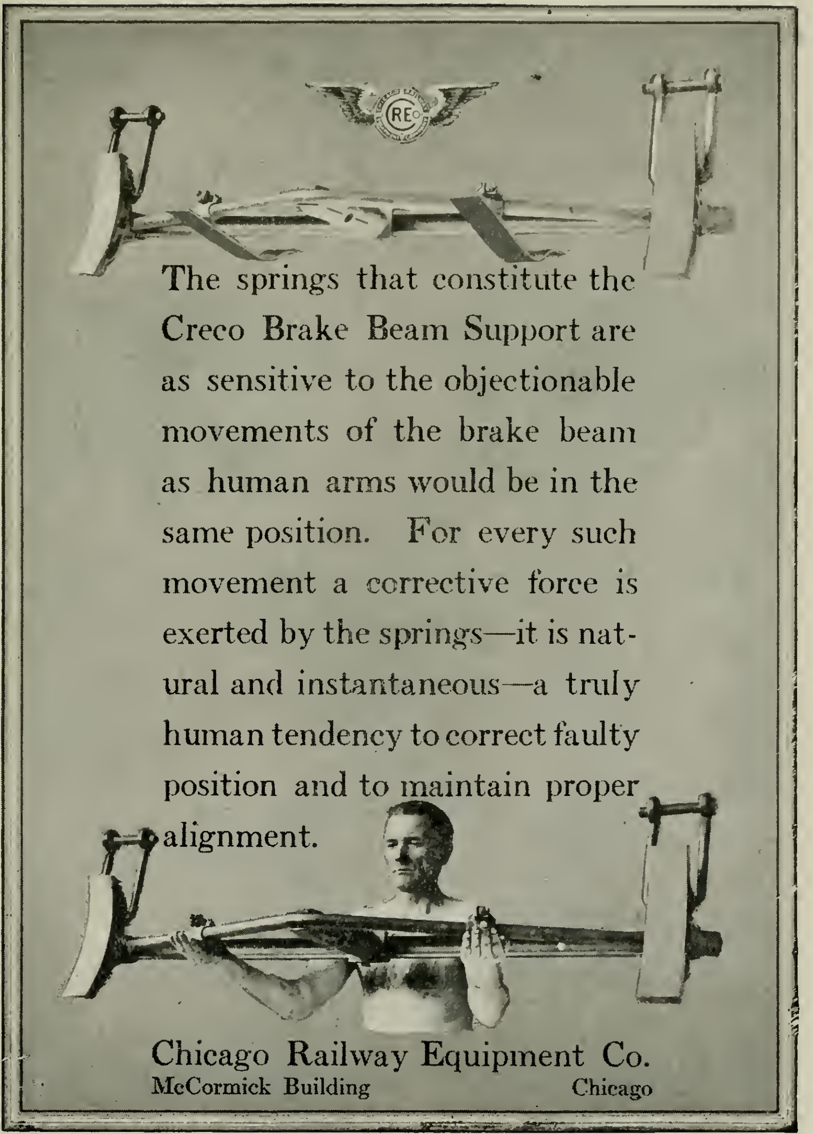

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Organized October 18, 1901.

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Pittsburgh, Pa., Apr. 27, 1922

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Past Presidents

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L. H. TURNER	November, 1903,	to October, 1905
F. H. STARK	November, 1905,	to October, 1907
*H. W. WATTS	November, 1907,	to April, 1908
D. J. REDDING	November, 1908,	to October, 1910
F. R. McFEATTERS	November, 1910,	to October, 1912
A. G. MITCHELL	November, 1912,	to October, 1914
F. M. McNULTY	November, 1914,	to October, 1916
J. G. CODE	November, 1916,	to October, 1917
D. M. HOWE	November, 1917,	to October, 1918
J. A. SPIELMANN	November, 1918,	to October, 1919
H. H. MAXFIELD	November, 1919,	to October, 1920
F. J. LANAHAN	November, 1920,	to October, 1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING

APRIL 27, 1922.

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock p. m., President Samuel Lynn in the chair:

The following gentlemen registered:

MEMBERS

Adams, Lou
Adams, W. A.
Anderson, A. E.
Babcock, F. H.
Bagnall, R. V.
Barrett, R. L.
Battenhouse, J. M.
Beach, H. L.
Bell, R. P.
Berghane, A. L.
Blakley, T. M.
Boss, R. E.
Brower, J. E.
Chollman, E. L.
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Clark, C. C.
Clifford, L. R.
Code, C. J.
Code, J. G.
Conway, J. D.
Cunningham, H. R.
Cunningham, J. L.
Cunnningham, R. I.
Daley, John
Daly, P. J.
Dambach, C. O.
Daniel, J. V.
DeMoske, C. E.
Devans, E. J.
Dietrich, O. M.
Douglass, W. N.
Edwards, C. H.
Edwards, H. F.
Ellis, H. T.
Fendner, W. J.
Forrest, C. H.
Fowler, W. E., Jr.
Freshwater, F. H.
Frey, A. R.
Fults, J. H.
Galloway, C. L.
Gilg, Henry F.
Gillies, W. F.
Goda, P. H.
Hale, C. E.
Harger, M. L.
Harney, E. L.
Harris, John P.
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Hazlett, H. H.
Henry, C. L.
Hildenbrand, L. B.
Hoffman, C. T.
Hood, J. M.
Howe, D. M.
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Hudson, W. L.
Hunter, H. H.
Johnson, A. B.
Jones, E. A.
Jungbluth, Adolph
Kasnitz, J. J.
Kaup, H. E.
Kegel, R. C.
Kelly, Leo J.
King, J. W., Jr.
Klingelhofer, C. T.
Kranse, H. A.
Kummer, Jos. H.
Lake, A. H.
Laughner, C. L.
Lent, John F.
Long, H. P.
Ludgate, B. A.

Lynn, Samuel
Maliphant, C. W.
Marshall, C. A.
Matchett, H. K.
Meeker, H. B.
Miessner, V. H.
Millar, C. W.
Mitchell, F. K.
Moyer, O. G. A.
McGregor, D. C.
McKinley, Andrew
Newman, J. F.
Nicodemus, E. H.
North, D. P.
Olsson, N. A.
Painter, Joseph
Patmor, H. F.
Patterson, J. E.
Pehrson, A. K.
Pennington, F. W.
Proft, J. W.
Rabold, W. E.
Ralston, J. A.
Ramsey, R. S.
Rankin, B. B.
Rauschart, E. A.
Read, S. C.
Rhoads, G. A.
Rick, R. C.
Ruben, J. W.
Sattley, E. C.
Searles, E. J.
Seibert, Wm. L.
Seiss, Wm. C.
Smith, R. H.
Snyder, J. W.
Stamets, Wm. K.
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Waggoner, R. E.
Walter, W. A.
White, A. B.
Winell, K. O.
Wolf, H. M.

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Tarr, Geo. H.
Thomas, Jas. A.
Thompson, J. M.
Waldron, F. G.
Weiler, G. H.
Wharrey, W. B.
Yearick, R. O.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Adair, Harvey C., Gang Foreman, Pennsylvania System, 4933 Breesport Street, Pittsburgh, Pa. Recommended by R. C. Rick.

Anderson, Donald P., Lead Clerk, Pennsylvania System, 7209 Mt. Vernon Street, Pittsburgh, Pa. Recommended by R. C. Rick.

Baldwin, A. V., C. C. to M. M., Pennsylvania System, 1155 Liberty Avenue, Pittsburgh, Pa. Recommended by C. B. Gray.

✓Benz, F. A., Div. Engineer, B. R. & P. Ry. Co., DuBois, Pa. Recommended by A. B. White.

✓Brown, W. E., Asst. Chief Engineer, M. of W., Pennsylvania System, 1114 Pennsylvania Station, Pittsburgh, Pa. Recommended by H. G. Huber.

Bruner, H. L., C. C. to Engineer M. of W., Pennsylvania System, 320 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Bushman, Chas. S., Clerk, Pennsylvania System, Stanton and Highland Avenues, Pittsburgh, Pa. Recommended by J. E. Brower.

Carroll, John P., Shop Clerk, Pennsylvania System, 322 Princeton Place, Pittsburgh, Pa. Recommended by H. G. Huber.

Clapper, H. O., Gang Foreman, Pennsylvania System, 810 Penn Avenue, Wilkinsburg, Pa. Recommended by R. C. Rick.

Connors, W. L., Signal Supervisor, B. R. & P. R. R., DuBois, Pa. Recommended by A. B. White.

Covert, Wm. T., Engineer, M. of W., Pennsylvania System, 320 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Cuthbert, C., Gang Foreman, Pennsylvania System, 814 Wood Street, Wilkinsburg, Pa. Recommended by T. L. Shourek.

Fenske, Felix P., Clerk, Pennsylvania System, 4656 Gangwish Street, Pittsburgh, Pa. Recommended by C. S. Crouser.

French, George, Jr., Clerk, Pennsylvania System, 4816 Cypress Street, Pittsburgh, Pa. Recommended by C. B. Gray.

Furch, George, Enginehouse Foreman, Pennsylvania System, Butler Junction, Pa. Recommended by S. C. Read.

Gallagher, T. J., Gang Foreman, Pennsylvania System, 4209 Dunkeld Street, Pittsburgh, Pa. Recommended by R. C. Rick.

Garrity, J. H., Div. Freight Agent, B. R. & P. Ry., 315 Wabash Bldg., Pittsburgh, Pa. Recommended by A. B. White.

Gordon, John, Gang Foreman, Pennsylvania System, 210 Shady Avenue, Pittsburgh, Pa. Recommended by J. M. Morris.

Gowland, S. I., Asst. Gen. Storekeeper, Pennsylvania System, 518 Pennsylvania Station, Pittsburgh, Pa. Recommended by H. G. Huber.

Gray, G. W., Engr. M. of W., Pennsylvania System, 1112 Pennsylvania Station, Pittsburgh, Pa. Recommended by H. G. Huber.

Grimshaw, F. G., Supt. M. P., Pennsylvania System, 500 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Hardman, William M., Stockman, Pennsylvania System, 539 Jeannette Street, Wilkinsburg, Pa. Recommended by R. C. Rick.

Harper, A. M., Manager of Sales, Carnegie Steel Co., Carnegie Bldg, Pittsburgh, Pa. Recommended by D. M. Howe.

Harris, D. C., Clerk, Pennsylvania System, 3216 Lecky Avenue, Pittsburgh, Pa. Recommended by T. L. Shourek.

Harris, R. C., General Storekeeper, Pennsylvania System, 517 Pennsylvania Station, Pittsburgh, Pa. Recommended by H. G. Huber.

Hayward, Carlton, Production Checker, Pennsylvania System, 744 East End Avenue, Pittsburgh, Pa. Recommended by C. G. Skuce

Hill, Clarence, General Div. Acc't., Pennsylvania System, 317 Pennsylvania Station, Pittsburgh, Pa. Recommended by C. G. Skuce.

Hipps, Harry G., Clerk, Pennsylvania System, 7810 Edgewood Avenue, Edgewood, Pittsburgh, Pa. Recommended by C. G. Skuce.

Huff, Geo. F., Jr., M. P. Inspector, Pennsylvania System, 6040 Bryant St., Pittsburgh, Pa. Recommended by C. B. Gray.

Kasnitz, J. J., C. C. to Div. Engineer, Pennsylvania System, 5715 Rural Street, Pittsburgh, Pa. Recommended by J. B. A. Tracey.

Keppel, H. H., Div. Accountant, Pennsylvania System, 216 Pennsylvania Station, Pittsburgh, Pa. Recommended by W. E. Rabold.

Libengood, E. H., Gang Foreman, Pennsylvania System, 2811 Strachan Avenue, Dormont, Pittsburgh, Pa. Recommended by J. E. Brower.

Livingston, Edmund M., Production Checker, Pennsylvania System, Pitcairn, Pa. Recommended by H. G. Huber.

Maley, W. E., Supervisor of Bridges and Buildings, B. R. & P. Ry., DuBois, Pa. Reccommended by A. B. White.

Moeller, John J., Gang Foreman, Pennsylvania System, 1440 Lowrie Street, N. S., Pittsburgh, Pa. Recommended by J. E. Brower.

Moir, W. B., General Car Inspector, Pennsylvania System, 504 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Montague, W. T., Asst. Engineer M. P., Pennsylvania System, 506 Pennsylvania Station, Pittsburgh, Pa. Recommended by H. G. Huber.

Morrow, Robert T., Supt. Pittsburgh Division, Pennsylvania System, 314 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Mowery, F. J., Clerk, Pennsylvania System, 236 Hasting Street, Pittsburgh, Pa. Recommended by C. G. Skuce.

McKee, D. L., Foreman Carpenter, P. & L. E. R. R., McKees Rocks, Pa. Recommended by Samuel Lynn.

McNamee, W L., Lead Clerk, Pennsylvania System, 1155 Liberty Avenue, Pittsburgh, Pa. Recommended by C. B. Gray.

Orr, W. M., 2404 First National Bank Bldg., Pittsburgh, Pa. Recommended by W. C. Straub.

Ramsey, Bruce L., Clerk, Pennsylvania System, 1155 Liberty Avenue, Pittsburgh, Pa. Recommended by T. L. Shourek.

Reifsnyder, Francis R., Accountant, Pennsylvania System, 5913 Broad Street, Pittsburgh, Pa. Recommended by W. E. Rabold.

Riley, Raymond S., Clerk, Pennsylvania System, 228 Forty-fifth Street, Pittsburgh, Pa. Recommended by C. G. Skuce.

Schrecongost, C. P., Traffic Manager, Hillman Coal & Coke Co., 2101 First National Bank Bldg., Pittsburgh, Pa. Recommended by Wm. J. Brant.

Sloan, J. R., Chief Electrician, Pennsylvania System, 521 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Swanger, B. H., Clerk, Pennsylvania System, 7027 Bennett Street, Pittsburgh, Pa. Recommended by C. S. Crouser.

Walker, J. W., Chief A. B. Inspector, Pennsylvania System, 521 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. L. Cunningham.

Watkins, David R., Gang Foreman, Pennsylvania System, 3075 Texas Avenue, Dormont, Pittsburgh, Pa. Recommended by P. M. Cheesman.

PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

There being no further business, Mr. A. C. Fieldner, Supervising Chemist and Superintendent of the Pittsburgh Experiment Station, United States Bureau of Mines at Pittsburgh, Pa., addressed the Club upon the subject, "Gas Masks, Ventilation, Etc.," illustrated by pictures. Mr. N. A. C. Smith of the same Bureau gave an address, "Mexico and Its Oils," descriptive of operation of the Sinclair Consolidated Oil Corporation.

"GAS MASKS, VENTILATION, ETC."

By MR. A. C. FIELDNER

Mr. President and Members of the Railway Club of Pittsburgh:—I think there is a great deal in common between your interests and those of the Bureau of Mines. I cannot conceive of any organization which is more versatile than a railway club. You are interested in chemistry, physics, engineering, accounting, transportation, almost everything under the sun. The railroad touches all industry. We of the Bureau of Mines are likewise interested in many activities. Mining is one of our fundamental branches of industry. The functions of the Bureau of Mines are to conduct investigations designed to improve health and safety in the mineral industry, and to promote efficient development and utilization of mineral resources.

The Pittsburgh Experiment Station is the parent station of the Bureau, and of course the largest. There are 11 other stations situated in the different mining sections of the country. The Pittsburgh Experiment Station with a staff of 200 deals principally with the coal mining industry, with the applications of fuels in various industries, and with matters pertaining to safety in both coal and metal mining. At Bruceton we have an experimental mine for making experiments on mine explosions and explosives.

GAS MASK RESEARCH.

The mine safety investigations have to do largely with gases, explosions and ventilation problems. These experiments in mine gases and other gases led to the participation of the Bureau of Mines in gas warfare during the war. The entire gas laboratory of the Pittsburgh Station was turned over to the army at the outbreak of the war and spent its entire time during that period in research on producing poison gases and protection from poison gases. After the war, the Bureau of Mines developed the application of many of these gas masks to industrial uses; one particular application relates to the railroads.

GAS MASKS FOR RAILROAD TUNNELS.

There were a number of requests came to the Bureau as to whether the army gas mask was suitable for protecting locomotive firemen and engineers from the disagreeable effects of the exhaust smoke from locomotives while going through tunnls. In order to find out we put some of our men on locomotives. Mr. S. H. Katz and Mr. S. P. Kinney, chemists of the Bureau's gas laboratory rode locomotive cabs between Grafton and Parkersburg on the B. & O. R. R. and also on the Pennsylvania R. R. trains through the Gallitzin tunnel. A number of experiments were also made in the Schenley tunnel of the B. & O. R. R. near the Bureau of Mines. Samples of the contaminated tunnel air were taken and analyzed to find out what particular poisonous constituents might be present. There is one particular constituent of flue gas from locomotives which is called carbon monoxide, CO. This gas is very poisonous. It has the property of combining with the hemoglobin or red coloring matter of the blood, forming a compound which prevents the blood from taking up oxygen in the lungs. If you get into a CO atmosphere you virtually put the red coloring matter of the blood out of business so that it cannot carry any oxygen to the tissues of the body; you therefore suffcoate. Flue gas may contain more or less carbon monoxide (CO), the amount depending on the efficiency of combustion. If the coal is burned completely with an excess of air there will be no carbon monoxide, but if it burns with insufficient air there will be several per cent of carbon monoxide.

Analyses of the tunnel atmospheres usually showed percentages of CO less than 1-10 of 1%. We did get one sample in the Schenley tunnel containing 0.12%, others ran .07. 0.12% CO if breather for only ten or fifteen minutes will not do any harm. If breathed for half an hour it will produce a headache, and if breathed for three or four hours nausea and finally unconsciousness.

We did not find enough carbon monoxide in any of our experiments to justify the use of a special CO-mask for trainmen going through tunnels on non-stop runs. That made the problem easier because it permitted the use of the ordinary gas mask which will take out smoke, acid gases, organic vapors and the gases used in warfare, but it will not take out CO. Actual experiments with the army gas mask in the engine cabs showed that it afforded full protection to the wearer from smoke and sulphur fumes. However, it was too cumbersome an affair for quickly taking on and off on passing through tunnels.

We found that a small canister like this (exhibiting a sample) filled with a mixture of charcoal and soda lime, and a cloth filter would remove all the smoke, sulphur and other disagreeable fumes. It is a simple device, no larger than a Prince Albert tobacco can and just as easily carried in the pocket. The canister has a simple mouth piece and nose clip attached. The face and eyes are entirely free and exposed. This pocket respirator does not protect from carbon monoxide, therefore, will not furnish protection in case of a stalled locomotive. It is good enough for any ordinary run in a small unventilated tunnel during long exposure and it is much more efficient than a sponge, wet cloth or similar dust respirators now on the market.

FIREMEN'S UNIVERSAL GAS MASK.

City firemen may be obliged to enter atmospheres containing many different kinds of gases. We therefore developed a universal gas mask which had a canister with substances so arranged as to filter out all deleterious gases from the inspired air. In the fireman's canister which I have here, the lower layer consists of activated charcoal for absorbing organic vapors such as carbon tetrachloride, aniline, benzine, etc.; next is caustic soda on pumice stone for absorbing acid vapors such as nitric, sulphuric and hydrochloric acids; next is calcium chroride for drying the air as moisture interferes with the action of some of the absorbents. Next is a material called hopcalite (invented during the war) for removing carbon monoxide; and last a layer of silica gel for removing ammonia fumes and organic vapors. This gas mask is widely used by city fire departments in any place where there is sufficient air to support combustion of a flame safety lamp. It must be remembered that no gas mask can be used in low oxygen atmospheres. You cannot go with safety into a place where the oxygen has been burned out, as in a basement or cellar where a fire has been burning for some time, or in a coal mine. You must never wear a gas mask in a place where a safety lamp will not burn. You should always carry a flame safety lamp while using such a mask in confined spaces. If the flame goes out there is not enough oxygen to support life. In our mine rescue work in mines we use oxygen-breathing apparatus in which the wearer breathes oxygen from cylinders which are carried with him as part of the apparatus. Industrial gas masks are used extensively in the chemical and metallurgical industries for protection from noxious fumes and vapors.

VENTILATION OF VEHICULAR TUNNELS.

The ventilation of vehicular tunnels has been one of the important problems of general public interest on which the Bureau of Mines has spent considerable time during the last two years. If you ever tried to run your automobile in the garage with the door closed and did it very long you would not be here to tell about it. If you ran your car in any small garage for five minutes there would be generated enough poison to render you unconscious and cause death if not removed immediately. It is this poisonous property of automobile exhaust gas which imposes the serious problem in the ventilation of vehicular tunnels. Two years ago the engineers of the New York and New Jersey Bridge and Tunnel Commission came to the Bureau of Mines for aid on the problem of ventilating the proposed tubes under the Hudson river. They wanted to know how much carbon monoxide would be evolved from the automobiles and trucks passing through the tunnels, and how much carbon monoxide the people passing through the tunnel could endure without any noticeable symptoms. The first problem was studied at the Pittsburgh Experiment Station.

We borrowed 100 automobiles and trucks of various sizes and makes, and ran road tests over a mile course from the Bureau's station on Forbes to Wilkins avenue thence to Shady avenue. This course had a 3% grade; we also ran tests on a level course. We collected samples of the exhaust gas, and measured the amount of gasoline used in the test. These samples were taken to the laboratory and analyzed. From the analyses and the amount of gasoline used, we determined the amount of carbon monoxide given off at a given speed and under certain running conditions.

We found out something we had not expected. It was the first time a large number of automobiles were tested, in which no change was made in their adjustment. We tested them just as they came to us from the owner without any change of adjustment whatever. The tests therefore showed the actual efficiency of these machines in practice. The tests of seven-passenger cars showed that on the average 8 to 9 per cent of the exhaust gas was carbon dioxide; 7 to 8 per cent was carbon monoxide and 3.6 per cent was hydrogen. Carbon monoxide and hydrogen are combustible gases, hence over half of the volume of exhaust gases have heat in them, which, if the carburetor had been properly adjusted with the right amount of air, would have been completely burned in the engine and given greater mileage and greater efficiency.

On running the cars, ten miles an hour up a 3 per cent grade, five passenger cars showed 75 per cent completeness of combustion; seven passenger cars, 67 per cent; one and a half ton trucks, 69 per cent; 1½ to 3-ton trucks, 72 per cent; 3 to 4½-ton, 75 per cent; 5-ton and over, 78 per cent. The efficiency increased with the larger trucks and went down with the passenger cars. The reason for that is that the truck is adjusted to run at slower speed so that when running 10 miles an hour, these trucks were running at their maximum speed and at highest efficiency; whereas the passenger cars were running at lower speed and lower efficiencies than if they were running 25 miles an hour. The astonishing discovery from these tests is that from 25 to 30 per cent of the heat in each gallon of gasoline is going out in the exhaust as unburned gas.

The tests of 100 trucks and automobiles showed how many cubic feet of carbon monoxide would be given off under tunnel conditions. The second problem was "How much carbon monoxide can the passenger or driver stand who goes through such a tunnel?" A number of men were exposed for a period of one hour to various percentages of carbon monoxide (showing pictures). From these tests we were able to conclude that 4 parts of CO in 10,000 parts of air is perfectly safe for periods of one hour. The hemoglobin of the blood becomes saturated to about 12 or 13 per cent, which does no harm whatever. In the tests made exposure to 6 parts of carbon monoxide did not affect any one; 7 parts produced slight symptoms as headaches; 10 parts produced headaches in all cases. Four parts was accepted as the safe limit to use in tunnel ventilation.

Description of New York Tunnel.

We also made some experiments to determine the coefficient of friction inducts. This problem was investigated at the University of Illinois and was carried on jointly by the Bureau of Mines, the University of Illinois Experiment Station and the Hudson River Tunnel Commission. In the proposed Hudson River Tunnels the air must be changed 40 times per hour. On account of the high horse power requirement it is most important to so design the air ducts that the frictional losses are a minimum. The last part of the problem was to make actual experiments in a small tunnel of similar cross section to that proposed by the Hudson River Commission. This was done at the experimental mine at Bruceton.

These tests showed conclusively that it is feasible to ventilate vehicular tunnels efficiently and keep the carbon monoxide below a point where it would produce any noticeable effect in one hour. We have also made a number of other experiments in which men were exposed to small amounts of carbon monoxide repeatedly, day after day, to determine whether there was any possible cumulative poisonous effect. None has been found within the limits we have prescribed for tunnel ventilation.

I have described this particular investigation to show a type of safety work that the Bureau engages in, which may not seem to be directly applicable to mining, as a matter of fact it is very closely related to many branches of the mining industry. Carbon monoxide is a common constituent of after damp and gases from mine fires. It is the principal constituent of producers gas, and is found in most manufactured gas.

The tunnel gas investigation has incidentally called our attention to the conservation of our petroleum supply. Gasoline is one of our most important fuel resources. As our oil supply decreases we will feel the need of gasoline more and more urgently. We will ultimately have to fall back on our coal. We will need to invent some way to turn coal into liquid fuel.

There is plenty of coal but we need to give the chemist time to develop new methods of distilling coal whereby the yield of liquid fuel in the tars and benzols is increased. One of the ways of conserving gasoline is to carefully adjust the carburetor on your automobile and use as much air as you can. Do not be afraid to run on a lean mixture—you are probably running on a richer mixture than you need, and you can increase your mileage 20 per cent by using more free air.

Mr. Smith, who is in charge of the petroleum laboratory at the Bureau will give the introduction to the motion picture on "Mexico and Its Oils" and tell you something about what the Bureau is doing in petroleum research.

"MEXICO AND ITS OILS"

By Mr. N. A. C. Smith

Mr. President and Members of the Railway Club of Pittsburgh:—The films which you will see in a few minutes will tell you a great deal more about Mexico and her oil and conditions in the Mexican oil fields than I can tell you. But a few words in regard to the character of the Mexican oil and the history of the oil fields may be interesting. The first oil was found in Mexico some time before 1880, but there was really no commercial development until just before 1900.

You have probably all seen the oil wells here in Pennsylvania. Of course on the surface of the ground one oil well looks very much like another whether it is in Pennsylvania or Mexico or any other part of the world. But there are some rather peculiar features of the Mexican field. One of them is the tremendous size of the wells. A well here in Pennsylvania which would flow 1,000 barrels a day would get headlines in all the papers and create quite an excitement. In Mexico they would not say that was a well at all. They do not consider a well good for much unless it produces 100,000 barrels a day and there have been wells that produced 300,000, 400,000 and 500 000 barrels a day. In fact one of the biggest wells that came in started as a gas well and the first sign that they had struck oil was when the string of tools went up through the derrick. They had a ten-inch extra heavy valve on top of the casing and when they tried to close it the gas pressure stripped the threads and threw the valve in the air, And that well flowed wild for several days before they could get it under control at all. They finally brought it under control by building a clamp around the top of the casing and sliding the valve over and clamping it down.

Another peculiar feature of the Mexican oil is its character. You are probably familiar with Pennsylvania crude. It is fairly thin, and usually dark green in color. It has a rather pleasant odor, a good deal like high-grade gasoline. It can be used to make practically all kinds of high grade products, such as gasoline, some of the best kerosene made, and probably the best lubricating oils. There are two grades of Mexican crude, the light crude, which is a good deal thicker than Pennsylvania crude, jet black in color, contains about 4 per cent sulphur and has a very strong odor of H_2S, which you are familiar with in rotten eggs. In facts there have been quite a number of serious cases of H_2S poisoning of men working around the wells and handling the Mexican crude. The heavy Mexican crude is really a liquid asphalt. It is very black and thick and sticky. The crude is used largely for fuel oil. A large part of it is imported into this country. They have pipe lines running from the wells down to the sea coast where the oil is run into tank steamers and brought to this country to refineries on the Gulf coast and all along the Atlantic coast.

They make a small amount of gasoline from Mexican crude but as far as I know they are not making any kerosene because it contains too much sulphur and it would be too expensive to refine it. And they do not make any amount of lubricating oils because the oil is very asphaltic in character. So the majority of the oil is simply put through a topping still, the gasoline is distilled off and the rest of it is used for fuel.

Mr. Fieldner mentioned the fact that our oil supplies are not going to last forever. Just at present, statistics show that we are producing more crude oil in this country than we ever did before, but statistics also show that we are using more. 1921 is supposed to have been a very poor year financially, but we used more gasoline in 1921 than we did in any previous year. While Mexican oil does not contain much gasoline it relieves the situation by providing fuel oil and that sets free oil for gas making and incidentally it helps out domestic supplies very materially. So I think it may be said without question that if we had not had the Mexican product for the last ten years you would be paying a great deal more today for gasoline, for kerosene and for lubricating oils, in fact for all the products of petroleum.

(Movies shown here.)

PRESIDENT LYNN: The hour is getting late but I am sure Mr. Fieldner and Mr. Smith will be glad to answer any questions you may wish to ask.

MR. A. E. ANDERSON: I would like to ask about that 73 per cent efficiency in the motor busses. What is the situation on a day in Pittsburgh when it is so still and foggy that you cannot see across the street, with all that CO coming into the air, what is the effect and the danger from it?

MR. FIELDNER: An average five-passenger car of medium size produces approximately 1 cubic foot carbon monoxide per min. In the open air the exhaust is diluted tremendously and you would not inhale enough carbon monoxide to notice it. We made some experiments in the taxicab concourse of the Grand Central Station, New York City. The atmosphere in that was very smoky. The taxi starter stated that very often on days such as you describe he would get splitting headaches toward evening. That of course was due to the CO which he was breathing.

We took some samples and analyzed them. We found, in a few samples, as much as three parts CO in 10,000 parts of air, but generally the CO content did not exceed 1 to 10,000. The taxi starter was exposed to gas all day and the cumulative effect was enough to give him a headache. We have taken air samples in open streets as on Fifth avenue, New York, when it was very crowded. We did not get a measurable quantity of CO. Of course mechanics in garages have a great deal of trouble from headaches due to breathing exhaust gas.

COL. HOWARD L. BEECH: In a service station one of the large automobile concerns has a large pipe running around the rear of the stairs where they put in cars with connections to each car running the fumes out of doors.

MR. A. E. ANDERSON: I would like to ask what area that lake from that well that was shown developed into.

MR. SMITH: I am afraid I cannot answer that any better than was shown on the picture. The pictures were taken from different distances so it is hard to judge.

PRESIDENT LYNN: The hour is late and if there are no further questions I will entertain a motion to adjourn.

MR. A. E. ANDERSON: I think we owe a vote of thanks to these gentlemen for giving us this entertaining and instructive talk and exhibition and I would therefore move a rising vote of thanks.

The motion prevailed by unanimous rising vote.

There being no further business, upon motion meeting adjourned.

J. D. CONWAY, Secretary.

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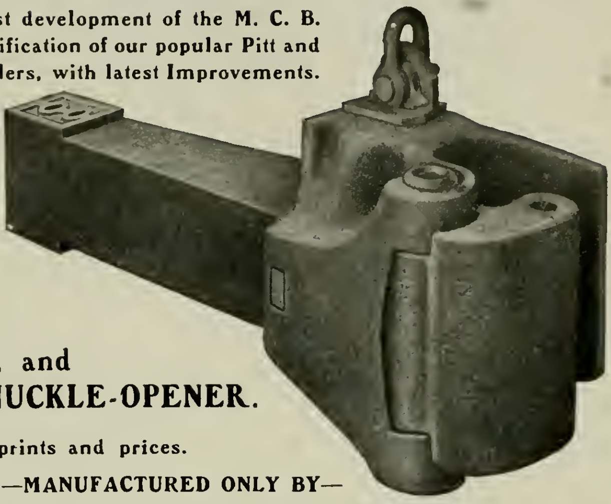

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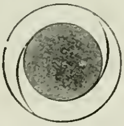

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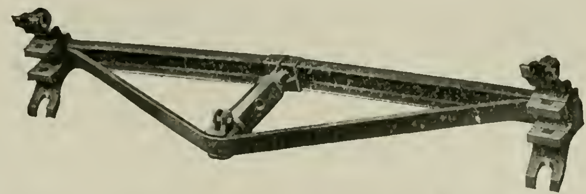

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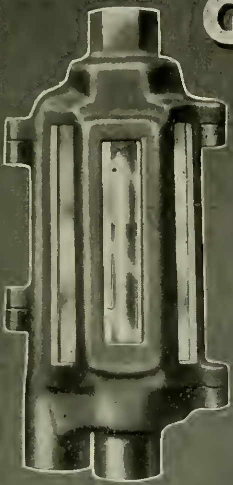

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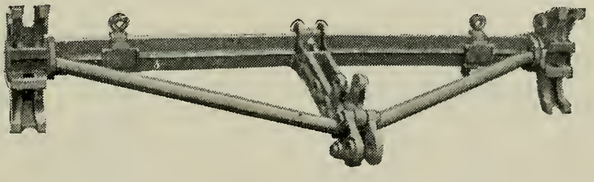

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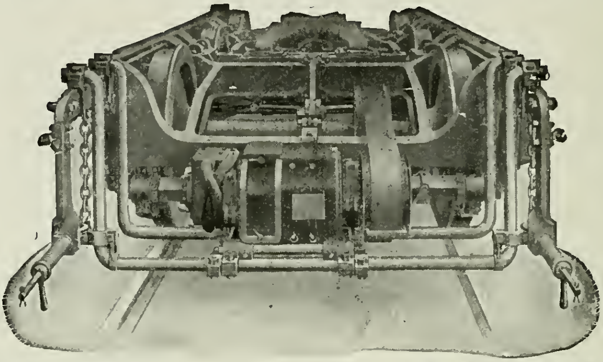

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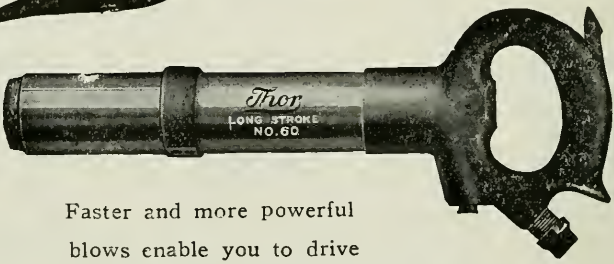

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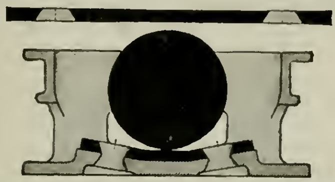

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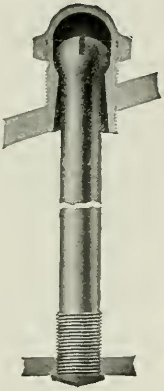

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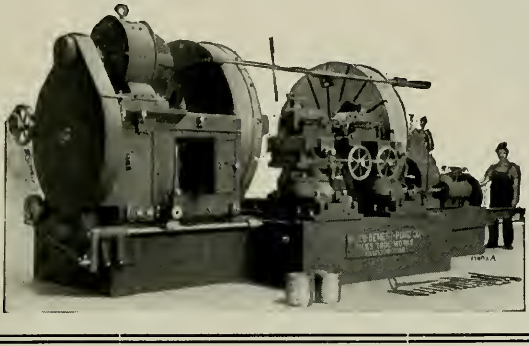

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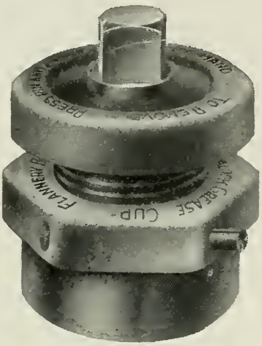

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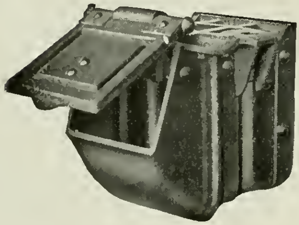

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Organized October 18, 1901.

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L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
D. J. REDDING	November, 1908, to October, 1910
F. R. McFEATTERS	November, 1910, to October, 1912
A. G. MITCHELL	November, 1912, to October, 1914
F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
D. M. HOWE	November, 1917, to October, 1918
J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
F. J. LANAHAN	November, 1920, to October, 1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
MAY 25, 1922.

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsurgh, Pa., at 8 o'clock P. M., President Samuel Lynn in the chair.

The following gentlemen registered:

MEMBERS

Adams, Lou
Anderson, A. E.
Anderson, G. S.
Babcock, F. H.
Bernoulli, W. H.
Boyer, Chas. E.
Brewer, G. D.
Brower, J. E.
Brown, W. E.
Carroll, J. P.
Cartwright, Wm. E.
Christy, F. X.
Connell, Wm. H., Jr.
Conway, J. D.
Cunningham, R. I.
Dambach, C. O.
DeVilbiss, E. B.
Downs, J. J.
Dudley, J. C.
Edwards, C. H.
Emery, E.
Fair, Chas.
Fink, P. J.
Forrest, C. H.
Freshwater, F. H.
Fults, J. H.
Garrity, J. H.
Geisler, Jos. J.
Glenn, J. H.
Goda, P. H.
Gordon, J.
Gray, C. B.
Gray, G. W.
Greene, W. F.
Hale, Chas. E.
Hansen, Wm. C.
Hardman, Wm. M.
Harris, John P.
Harris, R. C.
Haynes, J. E.
Hayward, Carlton
Hazlett, H. H.
Herron, B. J.
Hershey, O. W.
Hildenbrand, L. B.
Hindman, S. M.
Holmes, E. H.
Howe, D. M.
Huber, H. G.
Huchel, Wm. J.
Huff, Geo. F., Jr.
Hussong, A. C.
Johnson, A. B.
Jones, Ernest A.
Jungbluth, Adolph
Kegel, R. C.
Kelly, L. J.
Kempf, G. P.
Kindle, W. F.
King, J. W., Jr.
Kroske, J. F.
Lake, Albert H.
Lanahan, Frank J.
Lehr, Harry W.
Long, H. P.
Ludgate, B. A.
Lynn, Samuel
Lynn, Wm.
Maliphant, C. W.
Mason, Stephen C.
Matchett, H. K.
Meeker, H. B.

Merscher, John
Moir, W. B.
Montague, W. T.
Moore, D. O.
Moyer, Oscar G. A.
McAlpin, Samuel J.
McDermitt, W. W.
Newman, J. F.
Nicodemus, Earle H.
Olsson, N. A.
Painter, Joseph
Parke, F. H.
Passino, F. J.
Patmor, H. F.
Pehrson, A. K.
Peirce, E. C.
Peoples, J. S.
Perry, G. M.
Price, W. F.
Proft, J. W.
Quinn, J. M.
Rabold, W. E.
Rick, R. C.
Riley, R. S.
Ritts, W. H.
Robinson, R. L.
Sattley, E. C.
Schrecongost, C. P.
Searles, E. J.
Severn, A. B.
Shannon, D. E.
Smith, R. H.
Smith, W. L.
Stucki, A.
Summerfield, D. W.
Ternent, H. J.
Thomas, W. H.
Walther, G. C.
Watson, John
Watts, J. J.
Willoughby, F. R.
Wright, John B.

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Abel, W. M.
Acker, H. J.
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Alder, C. E.
Andrews, Guy L.
Bergman, O.
Bigelow, Geo. R.
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Deuser, J. M.
Dunham, C. W.
Echard, J. F.
Ferrall, C. L.
Frazier, Thos. A.
Fuerst, H. F.
Gable, M. G.
Gray, A. E.
Henderson, N.
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Heck, G. H.
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Masterann, Jos.
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Miles, C. B.
Rambo, R. E.
Rodgers, J. H.
Sisca, Alfred G.
Smith, Sion B.
Stenson, G. A.
Vogt, L. F.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Acker, H. J., Foreman, Pennsylvania System, 261 37th Street, Pittsburgh, Pa. Recommended by H. B. Meeker.

Bandi, John, Bill Clerk, P. C. & Y. R. R., 1115 Criss Street, Pittsburgh, Pa. Recommended by E. L. Harney.

Bigelow, George R., Clerk, P. & L. E. R. R., 121 Bertha Street, Mt. Washington, Pittsburgh, Pa. Recommended by E. K. Thomas.

Day, Paul, V. P. & Treas., Adair-Day Corporation, 1025 Widener Building, Philadelphia, Pa. Recommended by J. D. Conway.

Holmes, E. H., Asst. to Pres., Fort Pitt Malleable Iron Co., McKees Rocks, Pa. Recommended by Frank J. Lanahan.

Lackner, R. A., Vice Pres., Neely Nut & Bolt Co., 26 South 22nd St., Pittsburgh, Pa. Recommended by D. M. Howe.

Laird, E. C., Pres. & Managing Editor, The Railroad Herald, 316 E. 5th St., Atlanta,, Ga. Recommended by J. D. Conway.

Laird, George R., Clerk, Pennsylvania System, 140 Meadow Street, Pittsburgh, Pa. Recommended by W. E. Rabold.

Lytle, H. L., Clerk, P. C. & Y. R. R., 507 Woodward Avenue, McKees Rocks, Pa. Recommended by E. L. Harney.

Masterann, Joseph, Conductor, Pennsylvania System, Box 100, Hazzard, Pa. Recommended by S. A. Damore.

Noonan, W. C., Car Acc't, P. & W. Va. Ry., 926 Wabash Building, Pittsburgh, Pa. Recommended by R. L. Barrett.

Porter, Chas. E., Yard Master, P. C. & Y. R. R., 21 Phillips Avenue, Neville Island City, Pa. Recommended by E. L. Harney.

Vono, Dominick, Timekeeper, P. & L. E. R. R., 502 Cuff Avenue, Monongahela, Pa. Recommended by S. A. Damore.

Wey, Harry M., Rep., Pittsburgh Testing Laboratory, 7th and Bedford Avenues, Pittsburgh, Pa. Recommended by Harve B. Lauderbaugh.

Willoughby, Frank R., Clerk, Pennsylvania System, 114 New York Street, Edgewood, Pittsburgh, Pa. Recommended by W. E. Rabold.

PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

There being no further business, Mr. L. F. Vogt, Works Manager of the Standard Chemical Company presented the paper of the evening entitled:

"RADIUM"—The Wonder Element

By

LOUIS FENN VOGT.

Gentlemen: When Mr. Lent asked me to talk to you about Radium, I confess I finally accepted the invitation with some misgivings, wishing (as most of us do now and then) that I were a clever public speaker, and not just a production man. If you will accept me, however, as a production man, I will be pleased if so fortunate as to afford you an interesting glimpse of a big subject.

It is perhaps of special local interest to mention that Pittsburgh is the birthplace of the Radium industry in America. It was here, in 1913, that the first Radium was extracted in America, after two years of pioneering effort, and it has been here that two-thirds of the world's available Radium has been produced.

An effort will be made to make the subject, "Radium the Wonder Element," popularly interesting, rather than deeply scientific. It will be necessary to touch a little on the scientific status of Radium to get a true conception of what Radium is and means, for Science and Radium are closely associated.

The subject will be covered in the following sequence:

Present Status of Redium; Characteristics; Uses; Story of the Discovery of Radium; Pioneering of Radium in America; the Mining of the Ore; Extraction; Alloys of Vanadium and Uranium.

THE PRESENT STATUS OF RADIUM.

Radium, the wonder element, the mysterious, a key to the unknown in science and in the arts, is generally classed as one of the present wonders of the world. Radium has forced anew the conviction that all things are possible and that science is making almost incredibly rapid progress toward something, as yet indefinite, but certainly tremendous and comparatively close.

One need only pause a little to go over what has happened in the last few years, to feel this sentiment.

Radium is a so-called element to conjure with in its wonderful possibilities, almost unlimited. Although much has been learned about Radium, much remains to be discovered. Little of the mystery of its being is as yet known, of its parentage, childhood, maturity and death. It seems almost to be possessed of a mysterious spirit, in the energy it gives off and effect it has on life. The ordinary elements we have known seem stolid and unemotional in comparison, not changing apparently as the centuries go by; while they do little of themselves to explain the wonders of science and of the universe.

Radium is generally conceded to be an element, but the old conception has been that an element is something unchanging, fixed and tangible. An element has been defined as "A substance which cannot be decomposed by any known method," such for example as Iron, Carbon and Oxygen.

Our ideas of elements are being rapidly changed. In Radium we have a so-called element going through transformations quite at variance with the usual conduct of well behaved elements such as we have known. The ancient alchemists dreamed of transmuting common base metals or elements into gold, and others since have been for and against the possibility of transmutation, but now we have something similar in Radium, and having this, we may quite reasonably expect to realize the alchemists' dream sooner or later, as an interesting incident in the development of our knowledge of atonic matters.

Radium comes from the decay or decomposition of Uranium, another element, during the course of thousands of years, probably from some particular kind of particle making up the Uranium atoms. It is hardly conceivable that the comparatively large tonnage of this element is *all* going to Radium ultimately.

Uranium had been known for many years before its radioactivity was discovered. It breaks down through a number of distinct products, each of different atomic weight and chemical characteristics, such as Uranium X, Uranium X-2, then Ionium, which in turn changes to Radium. Radium then decomposes by steps through many definite products, Radium A, B, C, etc., F being Polonium and down to G, which is radio lead, a clear case of atomic disintegration, the drop in atomic weight having been from 238 for Uranium to 206 for radio lead.

A somewhat similar series of radio active decomposition products is formed from Thorium and another series starting with Actinium, which is itself a disintegration product of Uranium, each finally goes to lead of slightly different atomic weight. That from the Uranium series being 206; from Thorium 208 and from Actinium 207. This is of course not ordinary lead and may ultimately be found not to be lead at all.

It is notable that ordinary lead is the best known substance for stopping the rays of Radium, and for this reason it is used for lining containers for Radium to enable it to be carried without injury to the person.

In the progress of science, a basic discovery seems to come at more or less definite intervals, almost as if planned in advance, enabling further progress to be made. A new key is furnished to unlock another chest of mysteries at about the time scientists are prepared to go further toward perhaps the ultimate secret of the Universe.

Radium is without doubt such a key and basic discovery. The use of Radium, therapeutically, while very important and taking most of the Radium now produced, is to be of less importance, I believe, than its future scientific use. The researches made possible by it will have a great effect on civilization in the next few years.

Previous conceptions of physics, chemistry and electricity have been changed. The ultimate composition of matter may soon be known as an effect of Radium research.

The true significance of Radium is little realized at this time. A few men of science are awake to the possibilities. By means of the effects produced by alpha rays given off from Radium, Rutherford, a famous scientist, has broken down the atomic structures of Nitrogen, Boron, Fluorine, Sodium, Aluminum and Phosphorous, liberating Hydrogen from each. The alpha rays from Radium are in themselves particles of Helium, a rare and gaseous element, the particles being thrown off by Radium continuously at a speed of approximately ten thousand miles per second or twenty thousand times as fast as a rifle bullet. It is the most intense form of kinetic energy known.

When these particles of Helium, of the alpha ray from Radium, traveling at this great speed. strike the particles of the atoms of certain other elements, the impact amounts to an explosion, resulting in the breaking off of particles, leaving the atom quite different in its make-up and characteristics, being essentially a different element.

In Rutherford's work, Hydrogen was broken off from the atoms of the six elements mentioned, but the atoms of all elements, can not as yet be so broken down.

An atom is no longer the smallest particle of matter. It has been found that atoms themselves consist of a nucleus of "Protons," which are something, probably Helium or Hydrogen, having positive electrical charges and to these nuclei are attached by attraction "electrons" which have practically no mass and are essentially negative charges of electricity. These arrangements of nuclei and electrons may be compared with the solar systems, where the suns are the nuclei and the stars and planets the electrons, and like the solar systems, there is comparatively great space between the nuclei and electrons.

The number of Protons in the nucleus and number of electrons attached determines the kind of element. All elements, and therefore all matter, seem now to be mainly Helium and Hydrogen combinations plus electrical energy. The ultimate particle may be found to consist of Hydrogen only and electrical energy.

It may sometime be found possible to form elements at will, that is, to make tin, copper, iron, gold, silver, carbon, oxygen, etc., out of the ultimate atomic constituents.

The atomic energy involved in the possible creation of elements as outlined above is enormous—when the time comes that hydrogen may be converted into other elements, and that may be soon, each pound of Hydrogen so converted could possibly liberate intra-atomic energy equivalent to the power obtainable from twenty million pounds of coal. Ten thousand tons of coal per pound of Hydrogen, according to approximate calculations.

The reservoir of power stored up in the form of intra-atomic energy has not been unlocked as yet and is so far beyond our human comprehension in possibilities as to be almost infinite. The total power or energy represented by the coal deposits of the world are trifling in comparison. Coal is the stored up energy of a portion of that mysterious energy that comes from the sun. The use of coal for the production of power will sometime be considered crude work, and after all, coal will soon be exhausted and then what? Water power has a chance, but it too may become obsolete. Coal and water power equipment may become objects of interest in museums, 100 years from now, at the rate science is progressing.

Wireless telegraph and telephone are now becoming commonplace, yet the detection and use of these vibrations is only a key to the use of other vibrations between these vibrations and those of light, the mysteries of which still remain locked. We all know there are noises about us we cannot hear, things we cannot see nor feel, due to the limitations of the human senses, but which we can discover by finding the keys. *From present indications it will not be many years before it will be proved conclusively that all of the sciences lead back to one common origin, some ultimate thing or force, whether it be physics, chemistry, electricity or even biology.* In fact the first three seem to have already joined hands in the electron.

The final secrets of life may be attained sometime, somehow, and it looks as if mankind is to solve them finally. It is unbelievable that progress should stop, *and if not, what is the end* It seems unreasonable to believe that we are making these discoveries entirely of ourselves, with our human minds and bodies; it seems rather that the Divine must enter into it according to a seemingly well ordered plan of progress. The deeper we get, the more convincing it is, and our relations to the Supreme Being seem to join with the sciences in leading back to that same ultimate force.

I make no claims to be right nor for scientific accuracy and apologize for venturing to discuss matters verging perhaps on the deeply scientific, humbly admitting lack of knowledge. If it be permitted, however, to speculate and dream a little, it need cause no controversy, for after all speculation and dreaming must accompany all thought today on science and those things such as Radium, that assist scientific advancement; accordingly I venture the following:

In every scientific phenomenon, in all energy, in all life whatsoever, from the lowest to the highest forms, in every chemical reaction, in the soul of everything, there possibly enters an "Entity Z," so-called for want of a better designation, which is Divine, and is the actual controlling force that makes everything take place, scientifically. The thought is somewhat similar to the reasoning of Steinmetz as to his "Entity X" in "Science and Religion." His "Entity X," however, does not seem to quite cover the ultimate force that makes things take place which I venture to call "Entity Z." Perhaps the attainment of full knowledge of this force is the ultimate goal and end of science. There has been a tendency on the part of some to lose their reverence for the Divine in the study of science.

It does not seem inappropriate to me to make these remarks at this time on the eve of what seems to be an approaching scientific climax. The signs all point to imminent and tremendous scientific discoveries, followed by unprecedented changes in the means and manner of human progress.

However, there is an ominous black cloud on the horizon of civilization and the scientific progress of mankind. The cloud is Bolshevism. If this cloud envelopes the world, and the danger is great, scientific progress and civilization itself will fall into an abyss from which there may be no recovery. I feel like crying out, Awake! while there is yet time. Religion alone seems to stand in the way and even religion appears to be staggering under the load. Bolshevism is a destroyer of civilization and all that is precious and sacred.

To return to Radium itself, its present status has been indicated. It has been shown that Radium is a key to a knowledge of the ultimate constitution of matter, the thing, energy, force or whatever it may be, in which originate all material things and even the spiritual has been hinted in "Entity Z." From the mysteries present and future, we pass to the more definite present knowledge of Radium the element.

CHARACTERISTICS OF RADIUM.

Radium as generally used is a white powder, a salt of the metal, such as its chloride, bromide or sulfate. Radium metal itself is never used and in fact only one claims to have produced it, Madame Curie. These salts glow slightly in the dark and in most respects chemically resemble the corresponding barium salts. As a matter of fact, barium is generally associated with Radium all through the extraction and recovery processes to furnish a vehicle for the carrying of Radium from one step to another, so that the infinitely small amount present may be safely recovered in a considerable bulk of material. This barium is finally separated from the Radium, leaving a Radium salt of very high purity, the salt being what is meant by the word "Radium" today, broadly speaking.

These salts are radio active and reach their maximum normal activity about thirty days after the last production step. Radium is sold according to the milligrams of Radium element contained in the salts.

Radium gives off three kinds of rays, called respectively Alpha, Beta and Gamma rays. The alpha rays are discharged particles of helium, the Beta rays discharged electrons and the Gamma rays resemble light waves which travel at a speed of 186,000 miles per second.

The Alpha and Beta rays are stopped with comparative ease by rubber screens and do not have the deep penetrating power possessed by the Gamma rays, which are those of greatest value therapeutically. It requires thick lead to stop the latter. In some respects the Gamma rays resemble X or roentgen rays, but go deeper without damaging good tissue, and it is largely this ray that is used for the treatment of cancer. In this work the alpha and beta rays must be screened off so as not to burn the skin while the gamma rays are going in deep. A very large number of cancer cases have been cured so that no recurrence of the trouble has taken place up to the present. It seems odd that the gamma ray should single out only the diseased tissue in its attack and pass through the good tissue without harming it. Probably the diseased tissues have less power of resistance.

Radium loses its strength or activity at the rate of fifty percent in seventeen hundred years, gradually changing into other elements as explained before.

Sometime someone will find how to accelerate the transformation of uranium into Radium. It is a research of fascinating possibilities. The tonnage of uranium is something tangible and comparable with other elements with a means of converting it rapidly into Radium, the scientific and industrial possibilities stagger the imagination. Success might easily mean death to the fortunate one in the sudden liberation of energy, but who would not count his life well spent in leaving such an accomplishment for humanity?

It has been stated that if all the energy given off by a gram of Radium during its life could be liberated at once, there would be produced power enough to lift the Woolworth building some hundreds of feet, more or less, and if so it is interesting. Seriously, therein lies another fascinating research—how to liberate the enormous energy of Radium faster than fifty per cent in seventeen hundred years. Radium exhibits the following notable properties among others:

(1) The continuous emission of heat without noticeable loss of weight.

(2) Continuous emission of Helium and electrons.

(3) Causes vibration in the ether.

(4) Ionizes air and gases.

(5) Causes chemical reactions in substance exposed to its rays.

(6) The rays produce color effects in some substances, probably due to atomic disturbance.

(7) Promotes growth of plant life.

(8) Arrests and destroys certain malignant growths and is of great value therapeutically.

THE USES OF RADIUM.

The largest present demand for Radium is from doctors and hospitals, largely for use in treating cancer, in which service it has been particularly successful. Some other notable therapeutic uses include treatment of skin diseases and goitre.

Researches are going on continuously among the medical men to determine the effect of Radium on all diseases. The removal of birth marks without leaving a scar is an interesting side development, and the successful treatment of tonsils has lately been accomplished.

It is probable that nearly 90% of the Radium produced is being used as mentioned. In every large city of America, and almost of the world, Radium may be found in the hands of doctors and hospitals. One of the largest amounts in one place is probably nearly three grams possessed by the Mayo Brothers of Rochester, Minn. New York State has purchased Radium by state appropriation, the city of Philadelphia has bought two grams, and it is likely that other States and cities will follow, to provide their institutions with Radium, particularly for those who cannot afford treatment with it otherwise.

Radium is not used as a medicine, the powdered salt always remaining intact, sealed in a glass tube or placque. Only the rays given off through the walls of these tubes are used, so that the Radium is practically everlasting excepting for accidental breakage or loss. It occasionally happens that a tube of Radium worth perhaps ten thousand dollars gets thrown out with surgical dressings at a hospital, which is an easy thing to happen and generally leads to much excitement and search, and calls for assistance. Ine one such case a fifty milligram tube of Radium was lost. The suspected surgical dressings had been burned in a fireplace and the ashes had been spread in a neighboring back yard a block away. With an electroscope the operator placed on the search got negative results everywhere, trying to locate the Radium as usual by its radio active effect on the electroscope, until finally the ashes in the back-yard were reached and there the elctroscope showed the Radium to be distributed through the cinders. These cinders were gathered up carefully, sent back to Pittsburgh, were treated and approximately forty milligrams were recovered out of the original fifty lost, and were returned to the happy owner. It may be well to recall that it takes one thousand milligrams to make a gram and four hundred and fifty-three grams to make a pound, to visualize or appreciate the weight of the loss and recovery in this instance.

Another established use for Radium is in so-called Radium luminous paints, which you see commonly now on the dials of watches and clocks, to tell the time in the dark. This paint contains a very slight amount of Radium, as you may guess from the price, but that little is important. The paint is essentially luminous zinc sulfide, being a specially prepared crystalline variety, luminous of itself after exposure to light, but not for long.

When a slight amount of Radium is added the paint becomes continuously luminous, due to the bombardment of the zinc sulfide crystals by the rays from the Radium. This sets up a greenish glow which is entirely independent of the effect of sunlight and can be readily seen in dark places where sunlight may never reach. This continual bombardment of the zinc sulfide crystals by the Radium rays gradually destroys the crystals, until the luminosity is finally lost; not due to any failure of the Radium, for it remains substantially as strong as at first. The length of life of the paint depends on not using too much Radium and on the kind of crystals used. The necessary brilliance of the luminousity depends on using enough Radium. The compromise between the two generally results in good luminousity that lasts for from two to five years. Meso-thorium, a radioactive by-product of gas mantle manufacture is now coming into use somewhat as a substitute for Radium in the cheaper grades.

During the war our government and the allies used large amounts of this paint for naval instruments and aeroplane dials, also for gun sights and for many other things where lights must not be seen by the enemy, including the Doughboy's wrist watch. The amount of Radium consumed in this way is very small compared with the total annual output. There has been no shortage of Radium nor is there likely to be. Notwithstanding the assertions of alarmists, Radium production has kept up with the demand.

A third use of Radium, and ultimately the most important, is its employment in Universities and by scientists for research work. A few of the larger institutions now have Radium, but all should have quantities sufficient to enable them to join in the greatest researches man has engaged in, the investigation of atomic structure, the possibilities of which have been mentioned earlier.

THE STORY OF THE DISCOVERY OF RADIUM.

It was in 1898 that Monsieur Pierre and Madame Marie Curie discovered Radium. It was not until 1902, however, that the existence of the new element was proved to the satisfaction of scientists and the characteristics of Radium were made known The time was ripe for the discovery of Radium, in 1898, in that Becquerel and others had previously discovered and worked on radio activity, and it is doubtful if Radium would ever have been discovered except for its radio activity. In any known ore it is present in such almost infinitesimally small amount as to be beyond analytical methods such as apply to ordinary elements, and in ore it is not even reckoned in per cent content. It is only by means of its known relation to uranium and by electroscopic measurements of its radio activity that it can be detected and controlled during mining, extraction and recovery.

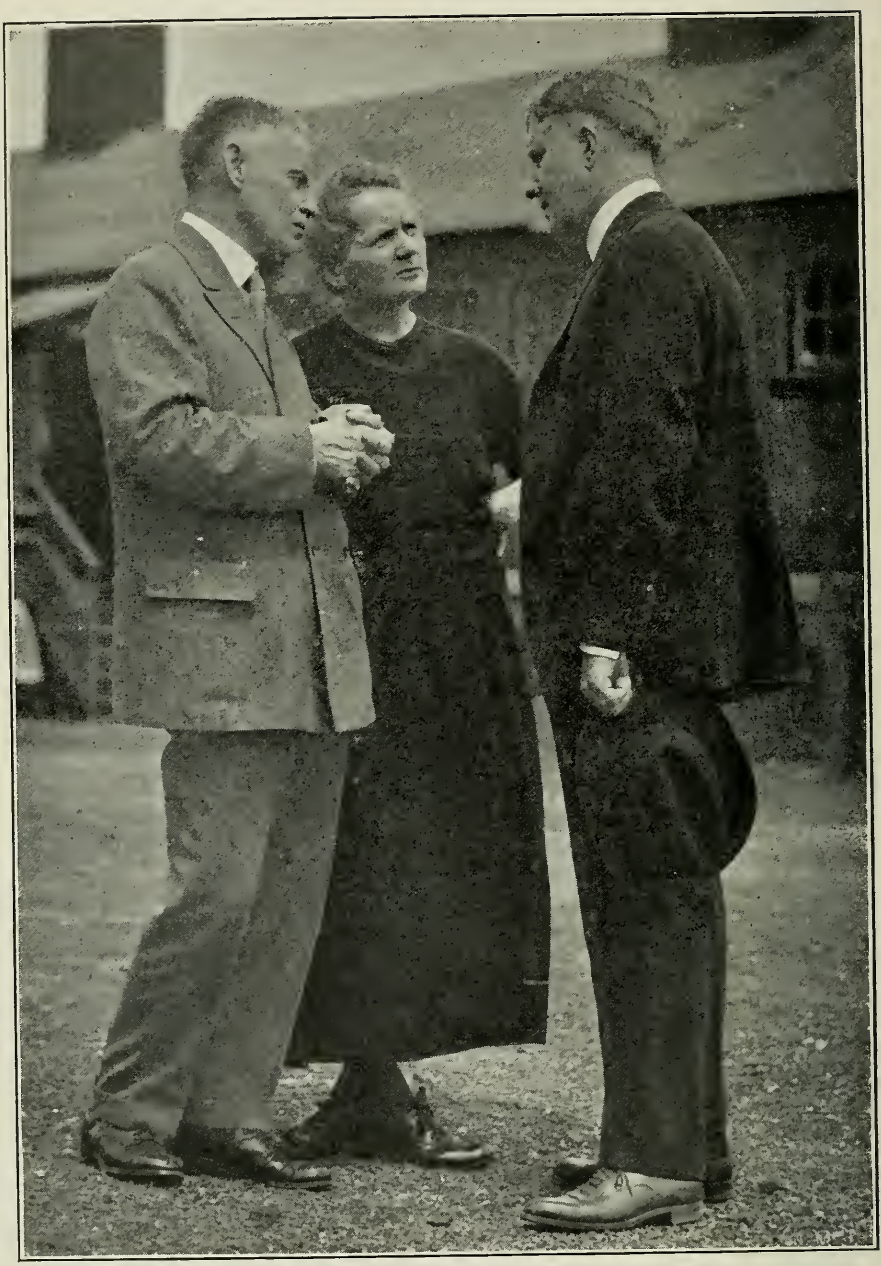
Almost immediately following Roentgen's discovery of X-rays, Becquerel in 1895 discovered that uranium is radio active, although uranium had long been known and had been used to color the fine Bohemian glass so well known.

This discovery of the radioactivity of uranium was in reality the first step in the discovery of Radium, which followed three years later. In 1903 the Nobel prize was awarded jointly to the Curies and Becquerel for the discovery of radioactivity and the new radio active substances.

Uranium had been extracted from the pitchblende ores of St. Joachimsthal. The Curies found the residues were more radio active than the remaining uranium accounted for, and this led them to suspect the presence of something hitherto unknown, of greater radioactivity than uranium.

After a long research under hardships and poverty, they finally succeeded in getting a radio active constituent concentrated to a point millions of times stronger in activity than the uranium Becquerel had observed and proved beyond dispute that this activity was caused by a hitherto unknown element, which they named Radium, because of the rays emitted. This research of the Curies' is a classic, as an example of clear visioned, systematic research, finally resulting in success.

Out of the apparently worthless refuse of the pitchblende



Madame Marie Curie discussing radium with President James C. Gray (left) and Works Manager Louis Fenn Vogt (right), of the Standard Chemical Company, upon her recent visit to America. Madame and Monsieur Curie discovered radium in 1898.

dumps, Radium was brought forth, to the amazement of science and disturbance of our conceptions of things in general.

Having discovered Radium, they proceeded to establish most of the data available as to the characteristics of the element itself. Monsieur Curie was unfortunately killed in an accident. The work is still being carried on by Madame Curie in her laboratory at Paris.

She has proved among other things that Radium gives off heat continuously; that a gram of it gives off sufficient heat in forty-five minutes to raise the temperature of a gram of water from freezing to the boiling point, and this goes on at a rate of scarcely noticeable diminution in a life time. Heat means energy, power and work and this heat is produced almost without appreciable consumption of the substance producing it.

The Radium produced by the Curies finally went to hospitals largely, and how it came to be used for the treatment of cancer is a story in itself. European medical men were about ten years ahead of the American profession on the use of Radium, therapeutically, when it was taken up here. The use of Radium in America had to be pioneered as well as the production of it.

Madame Curie discovered another radio active element, in 1898, just before she discovered Radium and named it polonium, after her native country, Poland.

It is recent history, how the women of America raised a fund of one hundred and twenty thousand dollars to purchase a gram of Radium and presented this gram to Madame as a token of appreciation of her great service to humanity. Madame and her two daughters were brought to America as guests last summer, and President Harding made the presentation at the White House in the presence of a notable gathering of scientists, diplomats and others of prominence. Very appropriately the Radium was furnished from Pittsburgh by the Standard Chemical Company, the company which has pioneered the extraction of Radium in America, and has produced most of that available in the world.

Next to possessing a quantity of Radium one of Madame's dearest wishes was to see how Radium is produced in America on the typical large scale so characteristic of American industrial undertakings. She was shown all the operations carried on at the Canonsburg, Pennsylvania, works, and at the refining laboratory in Pittsburgh. Some of the processes used were new to her, the American ore carnotite requires treatment differing from that used for the pitchblende ores of Europe.

The ore treated in America is very low grade compared with pitchblende and unlike pitchblende it contains vanadium in addition to uranium and Radium, which complicates the treatment. With so large a quantity of Radium as a gram, much may be expected from the researches Madame Curie is now carrying on.

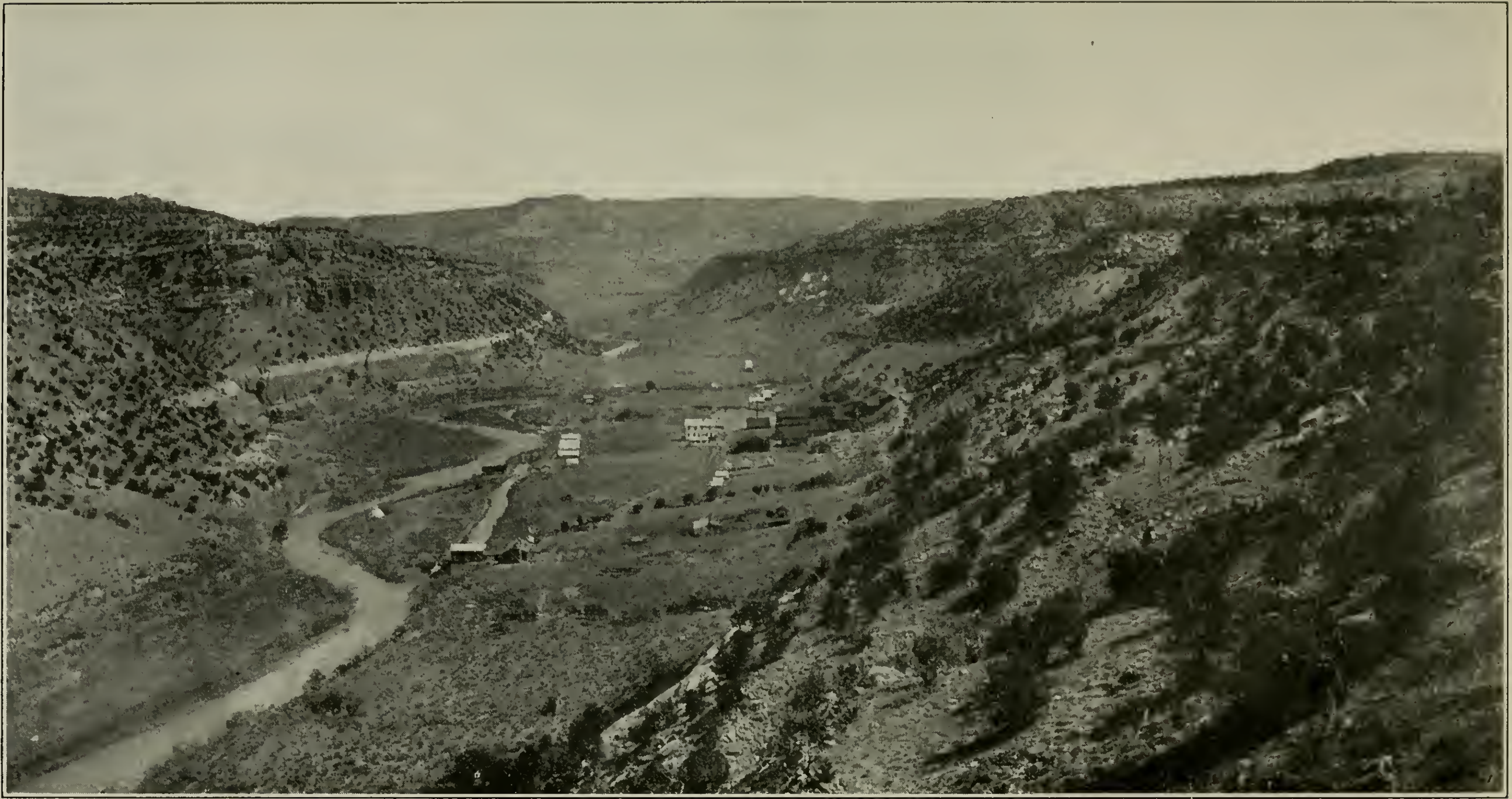
THE PIONEERING AND PRODUCTION OF RADIUM IN AMERICA.

The first activity toward the production of Radium in America started in the spring of 1911, when the late Joseph M. Flannery of Pittsburgh organized the Standard Chemical Company, as a result of his investigation of the therapeutic use of Radium in Europe. Even at that time it was one of the few hopes for the cure of cancer.

Mr. Flannery was a well known business man of Pittsburgh, having no scientific training. A death in his family undoubtedly influenced him to attempt the production of Radium. He had heard of the discovery of a low grade ore in Colorado called Carnotite. There was no established demand for Radium in America, there was no process for extracting it from this low grade ore, yet being a man of vision and nerve he went ahead. Ore claims were secured, technical men were engaged to work out processes and a works, small at first, was established at Canonsburg, Pennsylvania, twenty miles out of Pittsburgh.

After many disappointments and changes of technical force, a successful extraction process was finally worked out in the fall of 1912, and production started January 15th, 1913. Many difficulties were encountered, but one by one the troubles were overcome and production was successfully accomplished.

It was early found that there was no outside help to be obtained, and the little organization had to work out its own salvation. Many men would have given up in those early days, but not Mr. Flannery. He had just been through a pioneering proposition in starting the American Vanadium Company, a



Typical carnotite country in Colorado. In the center the largest mill in the world for the preparation and shipment of radium ore and a property of the Standard Chemical Company. Location 15 miles from Naturita.

remarkable success, so he was seasoned for the Radium struggle.

The odds were so much against success that now looking back it seems it was hardly a fair gamble. There we were, attempting to make a business success of treating ore from Colorado, coming from prospectors' claims mostly, with no definite knowledge of the extent of ore deposits or grade for the future; dealing with an ore containing a rare and little known element which could not be seen, heard, felt or tasted or reckoned in percentage anywhere during the attempted extraction processes until the finishing point after months of work; and all this for a product having no developed sales demand at the time in this country. It was, however, all brought to successful accomplishment.

During the first few years most of the output had to be sold in Europe to keep the company going, as the American demand was almost nil, and there was considerable discussion in and out of Congress about suffering humanity not being able to obtain Radium while it was all being shipped out of the country at such a rate that soon there would be none left.

The first year of the World War the company had to shut down because of the closing of European markets, but since then the American demand has steadily increased until doubtless more is bought here now per year than there was in the world ten years ago in finished condition.

The world's total output of Radium since its discovery in 1898 is probably not far from one hundred and fifty grams of Radium element, or about one-third of a pound.

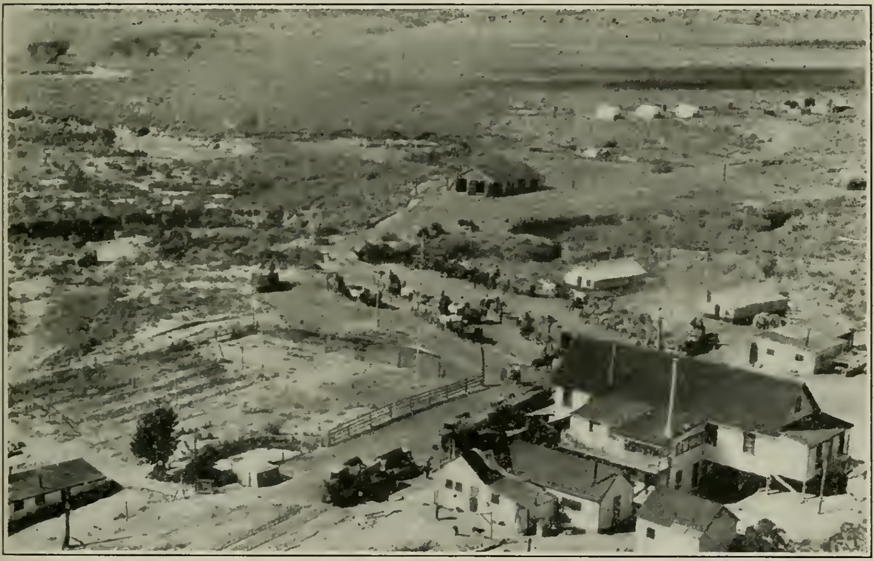
At the present price of one hundred and twenty thousand dollars per gram, the value of the world's approximate production of Radium to date is eighteen million dollars, and most of this has been produced in America by the pioneers, the Standard Chemical Company.

THE MINING OF THE ORE.

The mining of carnotite ore has developed from the first gophering efforts, to a well ordered mining district in Southwestern Colorado and Utah. Some of the more famous mines are in the region of Paradox Valley. This valley is so named because a river cuts directly across it, while the length of the valley is dry.

The ore is found largely in pockets. There are no well defined veins as in the usual mining. Carnotite is a yellow mineral, generally found coating and cementing together the sand grains of the ore, which is a soft sandstone. The more mineral in the sandstone the richer the ore until "high grade" is obtained, which is waxy and may contain very little sand. All Radium ores are graded on the per cent of uranium contained, calculated to oxide (u-3 o-8).

The mining of this ore has always been especially difficult. It is in an arid mountainous country, almost without roads until lately, and still nearly without railroads. A narrow gauge railroad at Placerville comes within sixty-five miles of the Standard Chemical Company's mill. Placerville is the general railroad point for ore and supplies for the district. Some of the ore claims are more than one hundred miles from a railroad.



A mining camp in the heart of the Carnotite belt in Colorado.

The ore in general lies comparatively near the surface so that some of it can be surfaced mined, but most of it now is obtained from extensive underground workings. About ten tons of rock is mined on an average to obtain one ton of ore. The great tonnage which must be counted on for the future runs less than one per cent U308 from present indications. Core drilling has been employed very successfully in locating and mapping out ore bodies. Much of the ore has to be transported for miles on the backs of burros down the mountain trails to the wagon roads; then by wagon trains for miles to the mill. Other camps more fortunately situated can now be reached by motor trucks after the construction of many miles of roads.

At the mill of the Standard Chemical Company the ore is treated mechanically to take out as much of the sand as is practicable and then is hauled 65 miles to Placerville. It is transported from there to Salida by the narrow gauge railroad. At Salida transfer is made to broad gauge, then the shipment starts on the final lap to the Canonsburg works, half way across the continent. It has taken more than two months to get the ore from the mine to Canonsburg. Mining and transportation expenses are obviously heavy. About two hundred and fifty men are normally employed by this company in Colorado.

Among the many tedius and laborious operations at the mines is the hand sorting of the ore to get rid of as much worthless rock as possible and thereby raise the grade. Some smaller Radium producers have been sorting their ore to obtain at least two per cent U308.

A two per cent ore will contain about 5.7 milligrams of Radium per metric ton of 2200 pounds. The average ore of the field is probably not more than one per cent, equivalent to 2.8 milligrams of Radium per metric ton. Just to refresh our memories, it takes one thousand milligrams to make a gram and four hundred and fifty-three grams to make a pound, so the average ore contains only one part of Radium to three hundred and fifty-six million parts of gangue or refuse mined, when the work commences in Colorado. When the ore leaves for its trip half across the continent to Canonsburg it contains a far more considerable amount of Radium, being one part per about eighty-eight million. It is commencing to be evident why Radium costs so much.

Miners at work underground in search of ore containing radium, the most precious element known to man. An ounce of gold is worth about $20.00, whereas an ounce of radium is worth more than $3,000,000.

The Standard Chemical Company has many mining claims in Colorado and Utah covering a large area. Other companies also have claims in this district as well as in Utah and Wyoming. Only a few of the claims are being worked and how much ore they all will ultimately produce no one can predict. One thing is sure, there is no immediate danger of exhaustion of deposits, for a large proportion of the claims are inaccessible as yet. Radium ore of various kinds is now being found pretty much all over the world, in Europe, Africa, Australia, Canada and elsewhere. A slight trace of Radium is present in sea water and in most soils.

EXTRACTION.

There are now several processes which will extract Carnotite ore with more or less success. Relative success is determined on per cent of recovery and costs. Since Radium is such an extremely valuable element, and since the mining and extraction are so costly, much money may be spent for a small increase in recovery, so percentage of recovery is exceedingly important.

The first industrially successful process in America for extracting Radium from carnotite ore was the soda ash fusion process first used at Canonsburg. This process enabled the Standard Chemical Company to start the production of Radium January 15th, 1913, after two years of general experimental work. The peculiar advantage of this process lies in the fact that nearly all of the other constituents of the ore are progressively removed from the Radium, leaving that as the near final product or residue rather than attempting to extract it primarily. The Radium is held insolubly associated with barium up to the final steps. The extraction of vanadium and uranium comes first, which considerably concentrates the Radium in the residue left for fusion. This is today probably the most positive and safe process for Radium ores of all kinds, for there is a great variation in ores, making some more refractory than others toward the usual hydro-metallurgical extraction. There are now cheaper methods, however. The tremendous increase in chemical costs during the war was against the fusion process.

A few years ago the United States Bureau of Mines worked out a nitric extraction process, but so far as the writer knows, it is not in use.

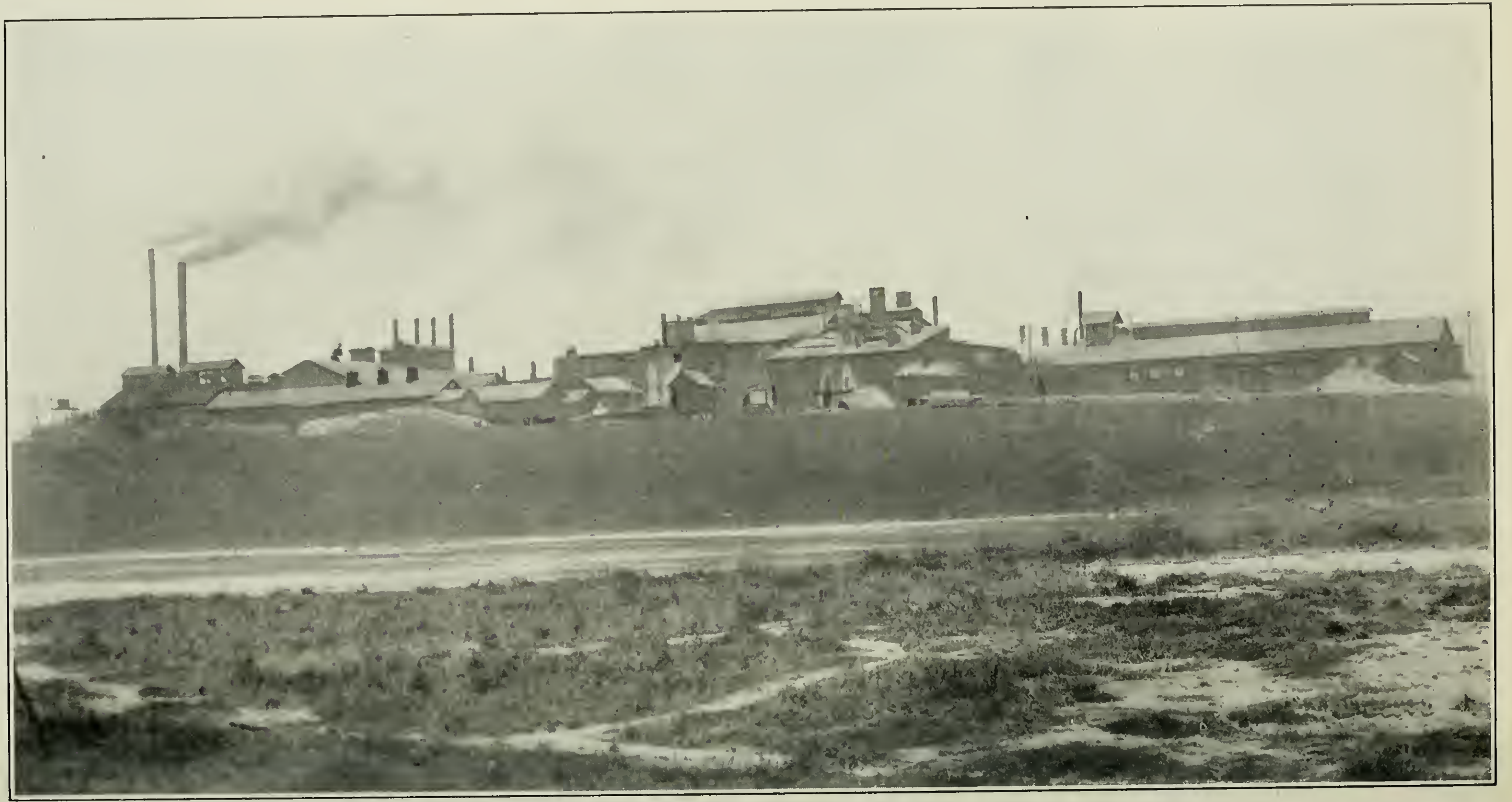
It may be stated broadly that most Radium extraction processes are now variations of soda ash and muriatic acid leaching, with the Radium finally recovered as crude radium barium sulfate. This is converted to radium barium chloride, and the radium chloride is then fractionated away from the barium chloride through systematic crystalizations, the radium chloride being more insoluble than the barium.

It requires many thousands of laboratory control tests and analyses each month to control the various production steps. It takes infinite patience and careful supervision to obtain ultimate success. Raw materials must meet the most exacting specifications, operations must be controlled within definitely fixed limits. Every preventable loss is safeguarded by safety equipment.

In any industrial effort the organization is of prime importance, and it is particularly important to the highly exacting processes required for the production of Radium. The matter of organization has been an important factor in the development of Radium production. It has taken years to train men to become expert in their various departments and to build up an organization sensitive and responsive to the new problems continually arising. What production executive has not felt that glow of satisfaction and pride in a competent group o men who can do things. You gentlemen know what it means in railroading. It may be compared to driving a high powered automobile in perfect condition and in which you have full confidence. The Standard Chemical Company's general organization from mines to sales has been called on to do things that have never been done before and it has more than met the hopes of the founder of the company. Few know what a fight it was in the early days. I am compelled frequently to mention the Standard Chemical Company, for it is inseparable from the story of Radium in America. As a production executive I could not write this paper without digressing a little to emphasize the value of organization and to give due credit to the general organization.

To return to extraction matters, the chemical engineering features of the Radium extraction equipment have been very difficult, as the processes in general are destructive to equipment causing expensive repairs and replacement. The extraction of carnotite ore is undoubtedly more complex and costly than the extraction of any other ore, and the production of Radium is costly almost beyond belief.

To produce a gram of Radium element with recovery of the by-products, vanadium and uranium in oxide form, it may be stated broadly requires the following: About five hundred tons of original average ore mined at high cost and transported long distances at large expense; approximately two hundred and eighty tons of chemicals, five hundred tons of coal; fifteen hundred tons of distilled and treated water among other items. The tonnage of ore and chemicals and coal alone would load a train of thirty freight cars, forty tons to the car, and the gram of Radium produced therefrom may be easily contained in a sewing thimble.



The works of the Standard Chemical Company at Canonsburg, Pa., where approximately two-thirds of the world's available radium has been extracted from the ore.

From the time the ore is first mined to the time the Radium is turned over finished to the U. S. Bureau of Standards for referee measurement, nearly six months has elapsed. It is necessary to age it for thirty days after it is finished and before measuring, so that it may become of normal activity. All Radium is thus sold and guaranteed on the Bureau's measurements, to avoid disagreements and to safeguard the purchaser.

When the crude radium barium chloride is brought to a concentration of approximately six thousand M. U. or six thousand milligrams per metric ton, the process becomes a laboratory operation of further fractionating out the barium until the Radium is up to the desired strength, and this is done in our Pittsburgh laboratory.

Many have been burned by Radium through ignorance or carelessness. In the early days, before the power of Radium was understod, a messenger carried a considerable amount from Paris to London in a vest pocket and was unconscious of any ill effects at the time. About two weeks later a bad burn developed where the Radium had been close to the flesh, and these burns are slow to heal. It was probably the first experience of the kind.

In the extraction of Radium no ill effects have been noted on the men, although it is not unusual to have several grams in process at a time. The effect of Radium emanation on the human organism seems to be to increase weight up to a certain exposure and beyond that to decrease it.

In addition to the Standard Chemical Company, Redium is now being produced by several other companies. The Radium Chemical Company is the selling company for the production of the Standard Chemical Company.

The founder of the Radium industry in America, Mr. Joseph M. Flannery, died early in 1920, but his work is being ably carried forward by his successor, Mr. James C. Gray, who was associated with Mr. Flannery in his many undertakings. The Radium industry is not only an industrial success, but it is a monument to the founder in the benefit it is to humanity.

In closing this general story of Radium it may well be kept in mind that this is by far the most precious material known to mankind. An ounce of gold is worth about twenty dollars, where an ounce of Radium is worth nearly Three Million Five Hundred Thousand Dollars, and á pound of it, were there that much in existence, would be worth more than Fifty-Four Million Dollars. The world's supply in finished form is now about three-tenths of a pound Radium element. Nowhere can we find a similar undertaking in the history of science and industry.

ALLOYS OF VANADIUM AND URANIUM.

In closing, it would hardly be fitting not to briefly mention what becomes of the vanadium and uranium contained in the carnotite ore from which the Radium is extracted.

The treatment of carnotite is complex largely because of the presence of three valuable elements, all of which must be extracted, then separated and purified, then recovered at highest possible percentages in products which can be used. What is good treatment for one is often detrimental to the others during extraction. Vanadium and uranium are recovered finally as oxides of high purity. These are made into ferrous and non-ferrous alloys by electric furnace or thermit processes.

The use of venadium in the manufacture of fine steels has been so thoroughly established as to need no comment. One can hardly stand anywhere today in civilized communities without being close to vanadium steel.

Uranium so far is used largely in high speed tool steel, giving the tools longer life and greater cutting efficiency. Uranium is also used in the ceramic industry. Application of uranium is in the pioneering stage and it is likely ultimately to occupy as prominent a place as vanadium now does.

Although carnotite ore only contains about one-third as much vanadium as the Patronite shipped from South America, the Colorado deposits are destined to ultimately supply a large part of the vanadium consumed in America, and it is well for our prosperity and safety that we have workable domestic resources in this respect.

The alloys produced by the Standard Chemical Company are sold by the Standard Alloys Company, a selling company only. The Vanadium Corporation of America is now the only other large producer of vanadium, since their absorption of the Primos Chemical Company during the war.

When carnotite ore was discovered and named for the Frenchman, Carnot, little could it be surmised what an effect his discovery was destined to have on civilization.

PRESIDENT: I am not going to say anything upon the subject of this mysterious element called Radium. I am going to leave that to you gentlemen in the audience. If you have any questions to ask, Mr. Vogt has kindly consented to answer them. The subject is now open for general discussion.

MR. L. F. VOGT: The Chairman should have said that I will try to answer questions. I will do so as far as I may be able.

MR. C. O. DAMBACH: I would like to ask how an institution down in Canonsburg found an element like this out in Colorado and how they got started in the first place out in Colorado.

MR. L. F. VOGT: Mr. Flannery, on a trip to Europe, heard of Radium and also heard in some way of this deposit in Colorado as containing Radium. He went out to investigate and found that the ore was there but he could not tell how much. Carnotite ore was known quite a number of years before that and it was known to be radioactive. It was used by the Indians for coloring paints before the white man discovered it.

MR. F. H. PARKE: Isn't there some danger in the process of reducing it? How do you protect your workmen against injury?

MR. L. F. VOGT: That is a very reasonable question. We sometimes have as much as two or three grams of Radium in process at one time. During the extraction treatment the emanations are driven off from the Radium but we do not have it in a very concentrated form. At Canonsburg we concentrate it to a very high concentration as compared with the ore. We then send it to our laboratories in Pittsburgh. In the higher concentrations they have to take certain precautions.

The general effect of Radium on men is for mild exposure to increase the weight. We do not have any trouble at the works at all. We have our "Old Guard" the same as the Westinghouse Air Brake Company or the railroad organizations, men who have been with us for ten years or more. In the early days I felt a little worried myself. None of us knew what was going to happen.

MEMBER: Do they use either of the other two rays, the Alpha or Beta rays?

MR. L. F. VOGT: They are used therapeutically some, for superficial skin diseases. The Alpha ray is used scientifically in the work of breaking up the atoms of nitrogen, boron, chlorine, phosphorus, aluminum, etc. The Alpha ray has many other uses but it is particularly useful and notable in the case of science, differentiating it from thereapeutically.

MR. W. H. THOMAS: Looking at it as a railroad man, how many tons of ore does it take to make an ounce of Radium?

MR. L. F. VOGT: It takes 500 tons to produce a gram and in an ounce there are about 29 grams—14,500 tons. That is really like the needle in the haystack or the mountain and the mouse; but the value is different.

MR. A. E. ANDERSON: It is quite interesting, the statement of the speaker that Madam Curie lost all the Radium she had in the explosion in her laboratory and that therefore the women of America undertook to contribute enough to supply her loss. What was that Radium converted into by that explosion? What became of it?

MR. L. F. VOGT: I do not know. It was not destroyed but it disappeared. It must have been spread over too much territory for them to be able to profitably extract it from the soil. Really, I do not know the details of it.

MR. A. E. ANDERSON: I would like to express my appreciation of this paper which is exactly the reverse of what we have been brought up on here in Pittsburgh. As I remember it, Rabbi Levy stated, that at a meeting where he was in conference over Pittsburgh matters, if he were not a minister he would say, "Damn the tonnage." That is all we think of in Pittsburgh. Here we have been taken to the other extreme, so much so that he was somewhat confusing in his complexity, to the lay mind. But the comparison of one part in so many millions would not apply in the Russian movement.

I think we should express by a rising vote, our hearty appreciation of the information which the speaker has given us tonight which will be supplemented in the printed report and of which I assure you I am going to make a very thorough study.

A rising vote of thanks was tendered the speaker for his very excellent paper.

There being no further business, upon motion the meeting adjourned.

J. D. CONWAY, Secretary.

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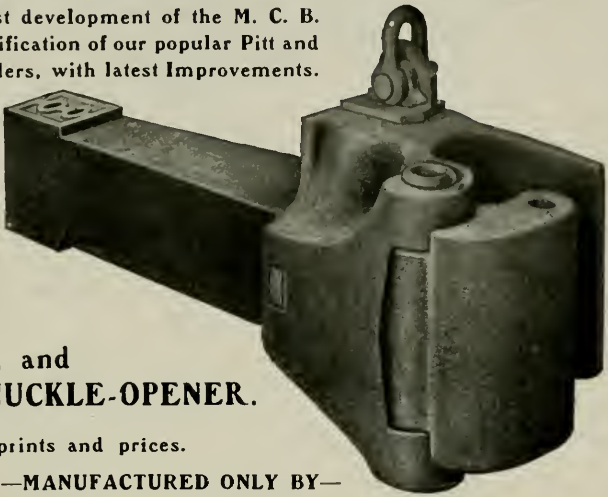

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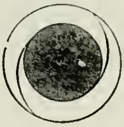

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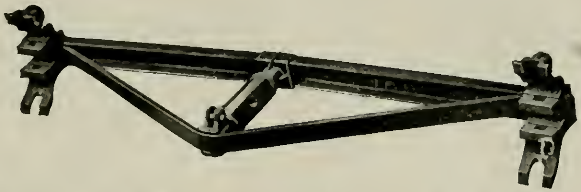

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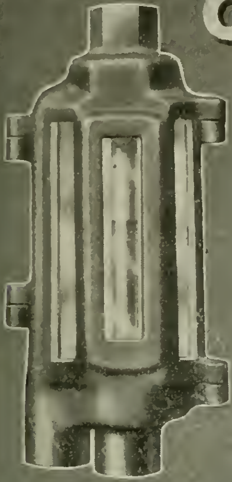

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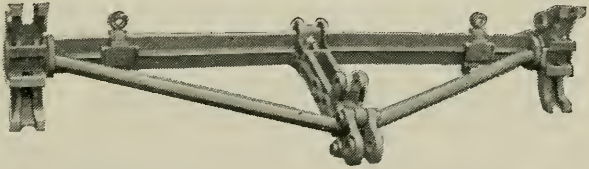

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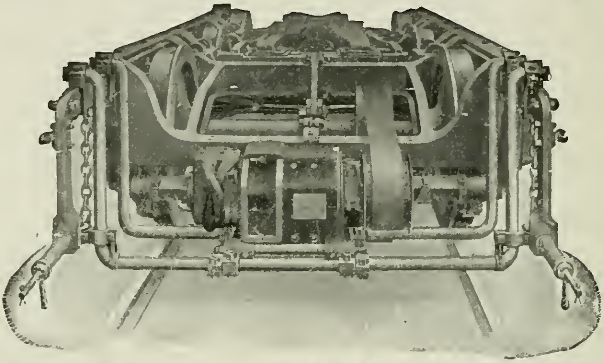

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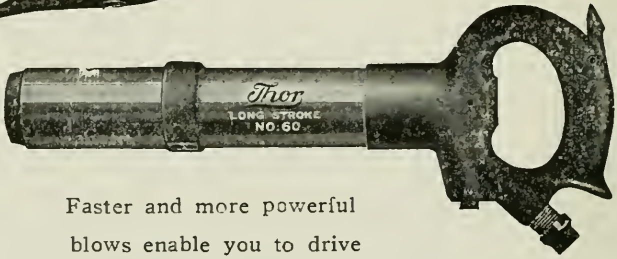

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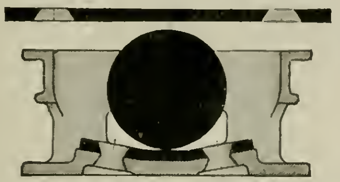

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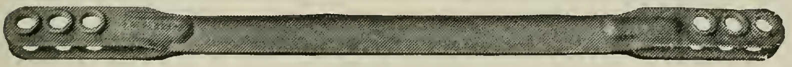

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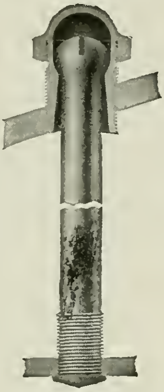

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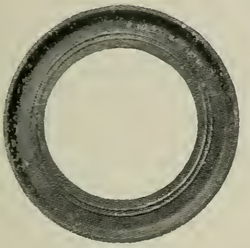

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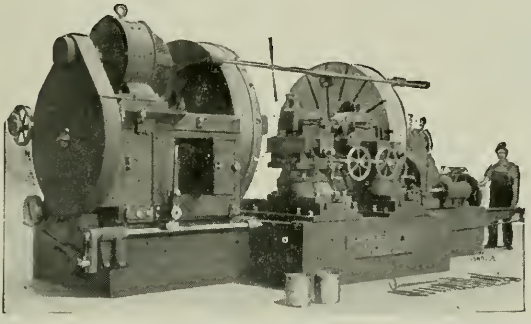

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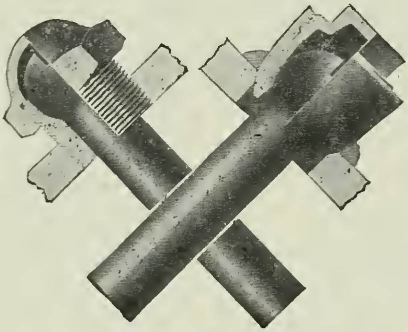

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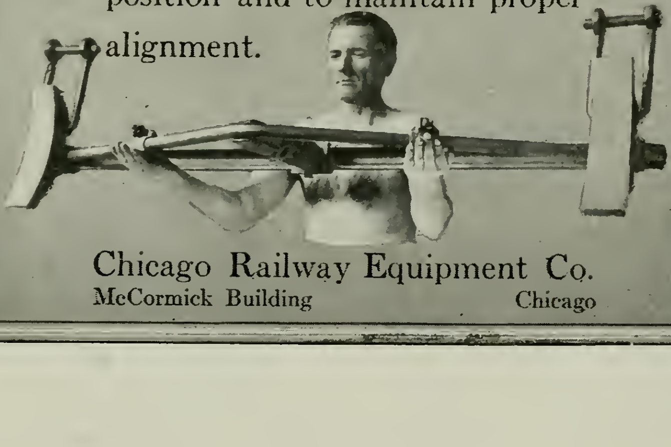

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F. M. McNULTY, Supt. Motive Power, Monon. Conn. R. R. Co., Pittsburgh, Pa
J. G. CODE, Pittsburgh, Pa.
D. M. HOWE, Railway Supplies, Pittsburgh, Pa.
J. A. SPIELMANN, Asst. to General Supt., B. & O. R. R., Pittsburgh, Pa.
H. H. MAXFIELD, General Supt., M. P., P. R. R. Co., Pittsburgh, Pa.
FRANK J. LANAHAN, President, Fort Pitt Malleable Iron Co., Pittsburgh, Pa.

Finance Committee

E. C. SATTLEY, President, Iron & Steel Products Co., Pittsburgh, Pa.
C. O. DAMBACH, General Manager, Unity Railways, Pittsburgh, Pa.
E. J. SEARLES, Schaefer Equipment Co., Pittsburgh, Pa.
G. W. WILDIN, General Manager, Westinghouse Air Brake Co., Pittsburgh, Pa
J. F. TOWNSEND, Traffic Manager, National Tube Co., Pittsburgh, Pa.

Membership Committee

A. STUCKI, Engineer, Pittsburgh, Pa.
F. G. MINNICK, Asst. General Manager, P. & L. E. R. R., Pittsburgh, Pa.
H. E. CHILCOAT, Manager, Clark Car Co., Pittsburgh, Pa.
J. A. RALSTON, Mechanical Engineer, Union R. R., Pittsburgh, Pa.
W. J. MURPHY, General Boiler Foreman, Pennsylvania System, Pittsburgh, Pa.
J. L. CUNNINGHAM, Supt. Motive Power, P. R. R. Co., Pittsburgh, Pa.
A. D. CHITTENDEN, Supt. Transportation, B. & L. E. R. R., Pittsburgh, Pa.

Entertainment Committee

E. EMERY, Railway Supplies, Pittsburgh, Pa.
HENRY F. GILG, Sales Manager, Penn Iron & Steel Co., N. S., Pittsburgh, Pa.

Reception Committee

F. H. FRESHWATER, Chief Draftsman, Pressed Steel Car Co., McKees Rocks, Pa.
J. L. SMITH, General Foreman, P. & L. E. R. R., Youngstown, Ohio.
HARRY B. KELLY, Road Fore. of Engines, P. & L. E. R. R., McKees Rocks, Pa.
E. V. WILLIAMS, Supt. Motive Power, B. R. & P. Ry., DuBois, Pa.
H. M. WOLF, Road Foreman of Engines, P. & L. E. R. R., Youngstown, Ohio.
S. E. VAN VRANKEN, Purchasing Agent, Locomotive Stoker Co., Pittsburgh, Pa.

Subject Committee

JOHN F. LENT, President, Lent Traffic Co., Pittsburgh Pa.
CHAS. ORCHARD, Traffic Department, Carnegie Steel Co., Pittsburgh, Pa.
JOHN B. WRIGHT, Asst. Dist. Mgr., Westinghouse Air Brake Co., Pittsburgh, Pa.
WM. J. KNOX, Mechanical Engineer, B. R. & P. Ry., DuBois, Pa.
E. B. DeVILBISS, Master Mechanic, Pennsylvania System, Pittsburgh, Pa.

Past Presidents

*J. H. McCONNELL	October, 1901,	to	October, 1903
L. H. TURNER	November, 1903,	to	October, 1905
F. H STARK	November, 1905,	to	October, 1907
*H. W. WATTS	November, 1907,	to	April, 1908
D. J. REDDING	November, 1908,	to	October, 1910
F. R. McFEATTERS	November, 1910,	to	October, 1912
A. G. MITCHELL	November, 1912,	to	October, 1914
F. M. McNULTY	November, 1914,	to	October, 1916
J. G. CODE	November, 1916,	to	October, 1917
D. M. HOWE	November, 1917,	to	October, 1918
J. A. SPIELMANN	November, 1918,	to	October, 1919
H. H. MAXFIELD	November, 1919,	to	October, 1920
FRANK J. LANAHAN	November, 1920,	to	October, 1921

*—Deceased.

Meetings held fourth Thursday of each month except June, July and August

PROCEEDINGS OF MEETING
SEPTEMBER 28, 1922.

The meeting was called to order in the English Room, Fort Pitt Hotel, Pittsburgh, Pa., at 8 o'clock p. m., President Samuel Lynn in the chair.

The following gentlemen registered:

MEMBERS

Adams, Lou
Adams, W. A.
A'Hearn, F. M.
Alexander, J. R.
Babcock, F. H.
Bateman, W. H. S.
Bell, R. P.
Berg, K.
Boss, R. E.
Boyer, C. E.
Carr, T. W.
Carroll, J. P.
Carson, John
Christy, F. X.
Clark, C. H.
Code, C. J.
Conway, J. D.
Courtney, H.
Crawford, D. F.
Croke, T. F.
Cunningham, H. R.
Cunningham, H. L.
Cunningham, J. L.
Daley, John
Daly, P. J.
Dambach, C. O.
Danforth, G. H.
Down, S. G.
Doyle, Wm. E.
Edwards, C. H.
Elsey, W. R.
Elverson, H. W.
Emery, E.
Fendner, W. J.
Fieldson, P. H.
Fowler, W. E., Jr.
Freshwater, F. H.
Frey, A. R.
Fults, J. H.
Gale, C. H.
Gardner, Geo. R.
Goda, P. H.
Gilg, Henry F.
Gray, G. W.
Greene, W. F.
Gwinn, L. J.
Hale, Chas. E.
Harger, M. L.
Harkness, W. S.
Haynes, J. E.
Hipps, H. G.
Holmes, E. H.
Hood, J. M.
Hord, P. R.
Howe, C. A.
Howe, D. M.
Huber, H. G.
Inks, S. W.
Johnson, A. B.
Jungbluth, Adolph
Kasnitz, J. J.
Kaup, H. E.
Kegel, R. C.
Kelly, H. B.
Kelly, Leo J.
Kempf, G. P.
Kindle, W. F.
King, J. W., Jr.
Kranse, H. A.
Laird, Geo. R.
Lake, A. H., Jr.
Lanahan, I. S.
Landis, Wm. C.
Lang, W. C.

Laughner, C. L.
Lehr, H. W.
Lobez, P. L.
Long, R. M.
Loshbough, L. C.
Ludgate, B. A.
Lytle, H. I.
Maliphant, C. W.
Matchett, H. K.
Meschtor, E. F.
Millar, C. W.
Miser, Chas. H.
Mitchell, T. J.
Moran, J. V.
Myers, W. H.
McConn, G. E.
McDermitt, W. W.
McGann, J. F.
McGowan, C. H.
McGregor, D. C.
McKee, D. L.
McNulty, F. M.
Nelson, W. O.
Newman, J. F.
Nieman, Chas. J.
North, D. P.
O'Brien, M. J.
Orchard, Chas.
Osborne, L. E.
Parke, F. H.
Passino, F. J.
Patmor, H. F.
Pehrson, Alfred K.
Peirce, E. C.
Rabold, W. E.
Ramsey, R. S.
Rauschart, E. A.
Read, S. C.
Redding, D. J.
Renshaw, W. B.
Riley, R. S.
Robinson, R. L.
Rogers, J. W.
Saltic, Thos.
Sattley, E. C.
Schrecongost, C. P.
Severn, A. B.
Sewell, H. B.
Shelhart, C. R.
Smith, R. H.
Snyder, J. W.
Snyder, Jos.
Spielmann, J. A.
Stahlman, M. C.
Stamm, B. B.
Stark, F. H.
Storer, N. W.
Stucki, A.
Suckfield, G. A.
Tucker, J. L.
Tummon, J. H.
Uhler, J. L.
VanVranken, S. E.
Walter, Chas. A.
White, C. C.
Williams, R. W.
Willoughby, F. R.
Winell, K. O.
Wright, John B.

VISITORS

Adams, L. F.
Alston, Arch., Jr.
Bowery, Frank J.
Boyd, Chas. C.
Byrne, J. J.
Carlsson, John
Collins, Harry M.
Cooper, W. M.
Evans, N. C.
Fletcher, R. H.
Flinner, John
Frauenhimer, A. M.
Hamilton, H. M.
Hamilton, W. C.
Hesse, S. H.
Hughes, Wm.
Krogh, F. F.
Lawless, F. J.
Lynam, W. F.
Lynde, L. E.
Mahan, W. C.
Meyer, W. J.

Miller, A. E.
Miller, F. E.
Musser, L. J.
McClintic, W. S.
McEldowne, R. W.
Newburn, T. W.
Noble, J. A.
Norbon, E. B.
Oyer, F.
Peacock, E. B.
Pilcher, John A.
Rambo, R. E.
Reese, F. T.
Reynolds, D. E.
Rock, D. E.
St. Clair, C. B.
Schrader, A. P.
Seem, C. B.
Shannon, J. J.
Shellenbarger, H. M.
Shultz, G. J.
Simpson, Robt.
Spalding, J. D.
Staman, H. Z., Jr.
Thomas, B. K.
Thomas, Geo., 3rd
Trist, N. B.
Tucker, J. J.
Van Verner, G. M.
Wagner, J. C.
Weaver, J. R.
Weiblen, C. W.
Wheatley, Wm.
Widmeier, L. W.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Bonhoff, E. L., Foreman, Pennsylvania System, 429 Rosedale St., Wilkinsburg, Pa. Recommended by J. L. Cunningham.

Bowery, Frank J., Checker, Pressed Steel Car Co., 214 Birmingham Ave., Avalon, Pa. Recommended by R. S. Ramsey.

Burkholder, H. E., Gang Foreman, Pennsylvania System, 220 Locust St., Johnstown, Pa. Recommended by J. F. Courson.

Burrell, D. H., Gang Foreman, Pennsylvania System, 617 Sixth St., Pitcairn, Pa. Recommended by C. B. Gray.

Caldwell, S. S., Gang Foreman, Pennsylvania System, 7010 Forest Way, Homewood, Pa. Recommended by H. G. Huber.

Carlsson, John, Draftsman, Julian Kennedy, 225 Fingol St., Pittsburgh, Pa. Recommended by F. O. Winell.

Collins, C. I., Foreman Tank Shop, Pennsylvania System, 484 Third St., Pitcairn, Pa. Recommended by C. S. Crouser.

Cooper, Harry, Gang Foreman, Pennsylvania System, 641 Sixth St., Pitcairn, Pa. Recommended by H. G Huber.

Emerick, Thomas, Gang Foreman, Pennsylvania System, 540 Gross St., Pittsburgh, Pa. Recommended by J. L. Cunningham.

Evans, L. F., Gang Foreman, Pennsylvania System, 509 Hawkins Ave., No. Braddock, Pa. Recommended by C. G. Skuce.

Feehrer, Maurice L., Gang Foreman, Pennsylvania System, 2310 Manor Ave., Swissvale, Pa. Recommended by W. R. Elsey.

Fletcher, R. H., Checker Engr. Dept., Pressed Steel Car Co., 35 S. Bryant Ave., Bellevue, Pa. Recommended by R. S. Ramsey.

Gipson, Samuel, Gang Foreman, Pennsylvania System, 121 Brinton Ave., Pitcairn, Pa. Recommended by C. B. Gray.

Gross, James A., Yard Master, Pennsylvania System, 139 Emma St., Greensburg, Pa. Recommended by M. T. Brendlinger.

Henderson, Nicholas, Jr., Gang Foreman, Pennsylvania System, 2690 Woodstock Ave., Swissvale, Pa. Recommended by C. G. Skuce.

Holt, Arthur E., Gang Foreman, Pennsylvania System, 1717 Crestline St., Wilkinsburg, Pa. Recommended by C. Hayward.

Johnston, W. A., Gang Foreman, Pennsylvania System, 449 Eleanor St., Pitcairn, Pa. Recommended by W. R. Elsey.

Lohr, Allan W., Experimental Tester, Westinghouse Air Brake Co., Tonnaleuka Club, Wilmerding, Pa. Recommended by H. S. Thorne.

Loutsenhizer, W. F., Work Distributor, Pennsylvania System, 624 Sixth St., Pitcairn, Pa. Recommended by C. G. Skuce.

Meschtor, E. F., Medical Examiner, Pennsylvania System, 401 N. Euclid Ave., Pittsburgh, Pa. Recommended by P. H. Goda.

McDonald, L. S., Gang Foreman, Pennsylvania System, Broadway St., E. McKeesport, Pa. Recommended by C. B. Gray.

Obermeir, Henry, Foreman, Pennsylvania System, 926 Brinton Ave., Pitcairn, Pa. Recommended by P. H. Goda.

Patrios, August, Gang Foreman, Pennsylvania System, 7147 Kedron St., Pittsburgh, Pa. Recommended by H. G. Huber.

Price, G. W., Asst. Foreman Tin Shop, Pennsylvania System, 403 Center Ave., Pitcairn, Pa. Recommended by C. S. Crouser.

Reed, F. W., Asst. Foreman, Pennsylvania System, 302 Edgewood Ave., Trafford, Pa. Recommended by J. L. Cunningham.

Rock, David E., Material Agent, Penna. System, 510 Elliott St., Wilkinsburg, Pa. Recommended by H. G. Huber.

St. Clair, Charles B., Gang Foreman, Pennsylvania System, 534 Lake St., South Fork, Pa. Recommended by C. S. Crouser.

Shultz, G. J., Gang Foreman, Pennsylvania System, 1018 Bedford St., Johnstown, Pa. Recommended by J. F. Courson.

Staman, H. Z., Gang Foreman, Pennsylvania System, 114 Stone St., Johnstown, Pa. Recommended by J. F. Courson.

Thompson, L. D., Gang Foreman, Pennsylvania System, 345 Kenney Ave , Pitcairn, Pa. Recommended by W. R. Elsey.

Tucker, John J., R. R. Dept., Joseph Dixon Crucible Co., 803 Finance Bldg., Philadelphia, Pa. Recommended by H. G. Huber.

Weaver, J. R., Gang Foreman, Pennsylvania System, 1483 Franklin St., Johnstown, Pa. Recommended by P. H. Goda.

White, J. W., Master Tinner, Pennsylvania System, 7239 Idlewild St., Pittsburgh, Pa. Recommended by M. T. Brendlinger.

PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

The President announced the appointment of the following members to serve on the Nominating Committee for officers for the ensuing year as follows: Messrs. D. M. Howe, D. J. Redding and J. L. Cunningham.

Announcement was made of the death of Joseph H. McConnell, the first President of the Club and of whose death we have but recently received word, no information being obtainable as to the date; Edward Kerr, Pittsburgh, Pa., died May 20, 1922; Charles S. Rea, Sales Manager, Ralston Steel Car Company, died August 1, 1922.

PRESIDENT: Appropriate memorial will appear in the Official Proceedings of the Club.

There being no further business, Mr. John A. Pilcher, Mechanical Engineer of the Norfolk & Western Railway Company, Roanoke, Va., presented the paper of the evening entitled:

THE DESIGN OF STEEL FREIGHT CAR EQUIPMENT

By John A. Pilcher.

The importance of the proper design of modern freight car equipment to the car owners, as well as the economic interests of the country at large, cannot be overestimated.

It is only within a little over twenty years that steel cars have come into general use. This development has been hastened by the increase in the price of lumber, the decrease in the price of steel and the demand for cars of greatly increased capacity. The use of steel makes it possible to build a car of any desired capacity, so far as the structure itself is concerned, the limitations upon size being only such as are placed by the clearances and strength of the roadway and other physical conditions surrounding operation.

The car constructed of wood, with the draft timber attached to the bottom of the center sills, equipped with the single-spring draft gears and the cast-iron link-and-pin draw bar, is a very resilient structure. This resillience was demonstrated by the fact that it was possible for so many years to successfully use the cast-iron draw head. We cannot imagine the use of a cast-iron draw head in a modern steel freight car with any expectation of having it moved any distance whatever. This resilience of the old car was, in a measure, a protection to the lading in the car.

The introduction of steel into car construction, while it allowed of any capacity and any strength necessary, developed a rigidity in the car construction which reflected itself in local damage to the car itself, as well as the lading, and made necessary the development of the modern shock absorbers, known as friction draft gears, so that one of the greatest problems we now have in car design and upkeep is to get and maintain sufficient and proper shock absorbers and coupler attachments.

When we look about us and see the large variety of steel car designs that have been developed we can appreciate that there are many points from which the important features of the design can be viewed. The primary feature to every designer is, of course, the production of a vehicle to haul the freight and produce revenue for the owner and user, but there are also various other features that have to be considered, and they present themselves in as many different phases as there are different minds working on the problem. It is my desire to point out to you some of the many important features that need be given consideration in the design of a steel car, with the idea, if possible of bringing to a discussion at this meeting something that will be helpful to all those present and to any others that may be interested.

If a railway car were subject to no other stresses than those of carrying the load the problem would be a simple one, indeed, and could be worked out on a basis the same as bridges where the conditions are more or less fixed. There would then be no reasons for not reaching a proper strength of construction for the definite loading. The fact, however, is that the car has to be started, moved and stopped without there being any definite speeds of acceleration and retardation or without there being any certainty as to the character of the roadway over which it is to pass.

The design of the car needs to be studied from many points of view. Among these I will mention the following:

The Owner and User:

1—This involves the weight of the car itself, cost, maintenance and the possible earning capacity, based upon the cost of the investment and the cost of repairs.

The Transportation or Operating Department:

2—Their idea is a strong car so as to relieve them of all burden of the supervision of yard switching crews. In this way they can cut down to a minimum the cost of switching service, which is a very large item in the cost of transportation.

The Claim Department:

3—They desire a car built in such a way that it will protect the lading from all possible weather conditions and be so resilient of itself that whatever is put in the car will never be damaged by any hurry-up movement in the yards.

The Car Builders:

4—The Car Builder desires a car that is very easy to build, one that can be put through the shop with the least amount of supervision; one that will give the maximum of output in shop production. He is willing to sacrifice a great deal to these considerations.

The Manufacturers and Sellers of Specialties:

5—These look upon the car as a structure upon which they can hang something that they have to sell. A large duplication of cars of the same type offers a wonderful field for exploitation for the specialty man.

For the Owner and User

The car must be constructed primarily to carry the most freight with the least dead weight, so as to bring up the revenue load and enable the car to earn the largest amount of revenue during its life. This feature can hardly be given too much prominence. Of course, like all good things, it is possible to carry it too far.

Lightness of structure does not necessarily mean weakness of structure. The car should, of course, be designed so that it will last through a reasonable period of years, or so it will not be everlastingly on the repair tracks, as a car on the repair tracks is a charge against interest and depreciation during that period without any corresponding income.

So far as the load-carrying capacity of the car is concerned, it is not a difficult matter to fix definite limits of stresses for its proper design. If we get fixed definite limits of speed of acceleration and retardation of the car in its movement and definite conditions of the track over which it is to be moved, it would not be a hard matter to fix the definite requisite strength of the car in every other way. It is at this point where different interests in railroad operation clash. It is the man in charge of moving the cars who is responsible for the speeds at which the cars are brought in contact in the classification yards. His idea is that he can save in the cost of classification by rushing the car movement. He should not fail to remember that every car he damages in this way costs him money in switching charges in that he has to take the car to the repair tracks and bring it back. In addition it also costs the company the loss of the time of the car and the cost of repairs, all charges coming from the same treasury.

It is possible to construct a car and make it strong enough to stand any kind of service to which it is liable, even without having the limits fixed for this service, but if a car should be made strong enough to stand any possible yard service it would be so heavy and so costly as to be of little value to the owner.

You will readily agree that every car should be made strong enough to stand any accelerating and retarding force that can happen to it while in train service or any type of brake application, but we do not believe it should be made strong enough to stand any kind of service that can be given to it in classification yards. Certain definite limits should be placed upon the rate of acceleration and retardation in the classification yards, or rather a definite maximum speed limit at the time of contact should be set and a large amount of supervision given in the education of the men to see that these provisions are carried out.

A great many of the car details have already been standardized. Through the instrumentality of the Master Car Builders' Association and the Mechanical Section of the American Railway Association, such items as wheels, axles, brasses, boxes, brake beams, brakes, couplers and parts, etc., have been definitely agreed upon. Certain other fundamental features of the car construction affected by impact have also been agreed upon, such as the standard cross-section of center sills, the minimum size and quality of draft yokes, and other features in connection with the draft gear, as well as definite dimensions affecting the fundamentals of the design. Studies are now being made as to the standard method of assuming the loading on the car and of the maximum allowable fibre stresses under such assumptions which will be allowed in the car framing itself, as well as the truck side frames, bolsters and others parts. This will be a wonderful step forward in unifying the art of car construction. It cannot, however, result in any permanent good unless there are some limitations put upon the usage of the car in the classification-yard service. We can hardly conceive of anything that cannot be damaged or destroyed if handled sufficiently rough.

The strength of the cars has been gradually built up in its power to resist end shocks, due to over-speed impact, from the old resilient wooden car through a series of modifications of the composite cars with various strengths of metal center and draft sills until we have reached the full steel car with a minimum of 24 square inches cross-section of center sills, which until the recent increase to 30 square inches, was the maximum.

A recent examination shows that cars constructed with the old limit of 24 square inches of center sills (which had been in use for several years) are sufficiently strong between the back stops to furnish reaction against which the shanks of the most modern 6 in. x 8 in. coupler can be upset. It is interesting to note that an examination of a group of such cars, sixteen cars being taken just as they were reached, showed three coupler shanks upset 1 inch; two 7/8 inch; three 3/4 inch; four 1/2 inch and the rest of the group from 1/4 inch to 1/2 inch. A later examination checking up these same cars indicated that one of these coupler shanks was upset as much as 1 1/4 inches. From this we draw the deduction that no cars should be brought together at a speed exceeding that which will bring the draft gear solid, as any excess of such speed is always liable to damage the cars, draft gears and couplers.

The old wooden cars with the wooden draft sills were all fitted up with dead blocks of some form. Through these the final shock on the car came directly on the end of the wooden end sills to the center sills and they were resilient enough to sustain these shocks for a long time. The doing away with the dead blocks brings the final shocks on the couplers, and with a clearance between the coupler horn and the striking face of the end sills these forces act directly upon the couplers, upsetting the shanks and driving the coupler heads back into the car and damaging the draft gears.

The damaging of the draft gears and the upsetting of the couplers, which allows the coupler head to be driven back into the car body, has made heavy repairs around the ends of the cars necessary, even though the sills are not damaged between the back stops. The general development of trouble at the end of the car has of late brought into evidence many efforts to overcome this damage by building on to the end of the sills very heavy steel striking casting against which the coupler horn and head will land without going back into the car. If these castings are made sufficiently strong they will, of course, protect the shank of the coupler and, in a measure, the draft gear.

at least to the extent of not allowing them to be compressed more than the slack between the horn of the coupler and the striking plate, but it will necessarily be at the expense of the coupler head containing the movable parts.

If there is no limitation placed upon the speed of the cars at the time of impact, these heavy striking plates will simply be anvils against which the coupler heads will, in a short while, be destroyed. Already the coupler horns have been suffering.

If the dead block, which was used in the days of the link-and-pin coupler and for a long time afterwards, is to be considered entirely a thing of the past, even though the danger from its use is also largely passed, because no one is allowed to go between the cars in making the coupling, would it not be a good thing if the coupler head were made with a rim all around to come against the heavy cast-steel striking faces on the ends of the sills, rather than depend upon the horn of the coupler alone?

I am offering in this a method of distributing these heavy loads to all parts of the coupler head rather than to concentrate them on the striking horn of the present couplers, which never was originally intended to be a striking part, but simply a projection through which the lift-lock lever protrudes.

Even if we should replace the dead blocks which, with resilient material behind them, would, in their shock absorbing capacity for heavy shocks, be equivalent to an additional draft gear, would we not still have to place some limitation on the speed at the time of impact? Protecting the cars from destruction would not protect the lading enclosed within a rigid car from serious damage.

The continual adding of material to the car adds to both the cost and weight. These very seriously reflect in the dividend of the owning and operating corporation.

We wish to illustrate just what this means by making a comparison of three groups of cars, built at the same time, coming under our observation not many years back. One group of these cars was built with the idea of increasing the revenue load to the maximum which, of course, meant the keeping of the dead weight to the minimum and correspondingly decreasing the cost. In connection with the design of these cars, a reasonable strength was not neglected, as they were made sufficiently strong to upset the couplers previously mentioned, which up to the present time have not developed any defects that call for extensive repairs that would in any way attract attention. The other two groups of cars are very much heavier, due to the character of the design and to the additional equipment with which they were loaded.

Considering a train of different groups of cars of 5.500 tons gross, including the cars and lading, the lighter cars have $759.10 more revenue in the train in the case of one group and $516.49 more revenue in the train in the case of the other group. Taking the cost of the train into consideration, the lighter cars cost $95,833.88 less than the one group and $74,212.50 less than the other group. If we allow interest and depreciation on the additional cost of 10% and allow twenty round trips per year with the equipment, it means that the lighter cars had an interest and depreciation charge of $479.17 less, per trip, than one group and $371.56 less, per trip, than the other group. If we add together the difference due to the interest and depreciation and the difference in revenue per train we have a difference in one group of $1,238.77, which is 12.32% of the gross revenue of the train, and in the other a difference of $888.03, or 8.62% of the gross revenue of the train.

These figures are very startling and show very clearly that great saving to the railroads can be made by so regulating the handling of cars in classification yards that the adding on of extra material in the hope of preventing break-downs, due to over-speed impact, will not be needed. The fact that the lighter car in question was sufficiently strong between back-stops to upset the shank of the latest A. R. A. coupler and strong enough to furnish the anvil against which the draft gears are being damaged, shows that the car is sufficiently strong in its present state, unless the couplers and draft gears are to be further strengthened.

Is it not a fact that this over-speed impact in yards, which is upsetting the shanks of couplers and damaging the draft gears and creating in the trains a large amount of unresisted slack is the primary cause of the damage to trains in transit from the emergency brake application and the passage of long trains over humps and through dips.

It is my belief that with trains of heavy cars properly equipped with modern draft gears, that have not been damaged and put out of commission or partially put out of commission by improper handling in classification yards, cannot be handled in ordinary train service in such a way as to bring about a sufficient differential in speed between the parts of the train at the time of impact to do any damage to either the equipment or the lading. I have recently been on very long, heavy special trains of new equipment, when the draft gears and attachments are in good condition, and have been impressed with the absence of these internal collisions. While these trains were equipped with special brake appliances which were being tested, I personally give credit for this admirable feature of operation to the condition of the couplers and draft gears and the absence of any great amount of unresisted slack.

This statement may lead to some difference of opinion and may open a way for considerable discussion, but in order to emphasize the important position, I will state that I believe that practically all of the break-in-twos of trains in service when the cars are equipped with modern draft gears and connections is entirely due to damage previously done in classification yards, either to the couplers, knuckles and pins themselves, or else in the fact that the compression of the coupler shanks and damage to draft gears has developed sufficient unresisted slack so there is opportunity for a considerable internal collision in the trains during movement.

To show how little can be gained by increasing the strength of cars, we have considered the impact test made by the United States Railroad Administration on the cars on the test track at Rochester, N. Y. At this time they not only tested various types of friction draft gears, but also made impact tests of cars without any draft gears. Drawing an analogy from these to show how little can be gained by increasing the strength of the cars, I call your attention to the following:

1—Assuming a 40-ton car weighing gross 132,000 pounds, with a center sill of 24 sq. in. cross-section, fitted with a draft gear that will go solid at an impact speed of four miles per hour, we find the reaction between the cars just as they go solid will be just 1.6 times the weight of the car, or 211,000 pounds.

2—If we consider the cars going together at 4.4 miles per hour, the force will be 3½ times the weight of the car, or

462,000 pounds. With 24 square inches cross-section, considering only direct stresses, this will give us 19,250 pounds per square inch. If the sill of this car were increased to 30 square inches, and using the same fibre stress, the force of reaction would have to be 580,000 pounds, which is 4.4 times the weight of the car and lading. This will represent an impact speed of 4.55 miles per hour for the same car. We could, therefore, by increasing the sill of this car from 24 to 30 square inches, or 25%, increase the impact speed of the two cars from 4.4 to 4.55 miles per hour, or .15 miles per hour, which is 3.4%. These figures are given in order that you may see how little increased speed at time of impact is gained by a very large increase in the cross-section of sills. This gives a proportionate increase in strength and unfortunately a proportionate increase in weight. It also gives an increase in interest and depreciation charge, and a proportionate decrease in earning capacity, and nothing like a proportionate increase in impact speed. It has only a very minor effect in the decrease in the cost of car repairs.

In recent years great efforts have been made to reduce the cost of transportation by large increases in the tonnage of the trains, primarily to increase the revenue per train. To do this very large locomotives have been built. This has been largely brought out by those in charge of transportation, who also have control over the equipment in the classification yards where, according to my belief, 97% of the damage to both equipment and lading is done. With more care in the handling of cars in the classification yards the expense and upkeep of equipment can be very materially decreased and the expense of the Claim Department materially reduced.

How far do you suppose the transportation officer would be willing to go in his efforts in the reduction of the cost of hauling freight if he could bring about a saving equivalent to as much as 10% of the gross revenue of the Railway Company he is serving? I should think he would be willing to undertake most anything. I have shown in a previous statement as between two groups of cars—one heavy and expensive and the other lighter and correspondingly less expensive, that there is a difference amounting to as much as 12.32% of the gross revenue of the train.

One of the serious features in connection with steel cars, and particularly open top steel freight cars, is corrosion. While the outside of the car can, in a measure, be protected by the use of coatings, the inside portion of the open top car is subject to the corrosive influence of the contents of the car. The dumping and handling of the loads prevent the use of protective coatings on the inside. After the car has been designed so as to carry the load and withstand the shocks of impact, it would last indefinitely, but for this corrosion.

Its final destruction can only be retarded by adding thickness to the material at certain points where corrosion is liable to be excessive, and at certain points where corrosion will weaken the structure, particularly as for instance, in the framing. It is very hard to determine just how much the designer is justified in adding at these points, because any amount added decreases the hauling capacity of the car.

It is very desirable in the construction of large open top cars for use on dumpers to use inside stakes. When the stakes are placed inside they are subject to the extra corrosion which must be allowed for in fixing their size. Shapes should be used offering the least possible surface for corrosion.

During recent years there has been considerable experiment made as to the value of copper-bearing steel for the purpose of retarding corrosion, using steel of approximately .20 per cent copper. The special tests that have been conducted and observations that have been made of former steel structures built of copper-bearing metal indicate that we may have a very considerable lengthening of the life of the car by the use of copper-bearing steel.

Every car must be looked upon as a package in which merchandise is being shipped. Any increase in the cost of the package, whether it is a car or a seperate package going into the car, is a charge against the transportation of that particular article. Every additional expense to the cost of these packages is an additional burden on the transportation of the article and may, in some cases, prevent its being moved at all by the railways. It is just on account of such additional charges in order to protect freight that the automobiles on highways are cutting so deeply into the revenue of the railways, along the side of which they operate. The high cost of cars and the high cost of packages can kill transportation just as easily as high freight rates, because all three go together to make up the cost of transportation.

The designer, above all things, wishes to produce a car that has a large margin over its light weight for lading and for earning revenue, but to get this there must be some limitation put on the speed at which cars are brought together, *and this should not be in excess of that which will bring the draft gears solid.*

2—*The Transportation Point of View*: I have already touched upon this point of view in the preceding paragraphs because they have been hard to segregate. The transportation man always wishes a car designed so strong that it does not have to be repaired and one that can be handled without undue care. The transportation people are responsible for keeping down the cost of handling, but it is also their method of handling that, to a large extent, brings about the necessity for repairs. If any compromise is to be arrived at as between the cost of handling and the cost incident to indifferent handling, and the cost of interest and depreciation and loss of revenue in the train due to heavy construction, some definite limitation of speed at the time of impact will have to be fixed, otherwise the designer has nothing definite to which to work and will continue to build cars, making each one stronger than the other. This tendency to make the parts that break a little bit stronger has resulted in each new design being built coming out a little stronger and having power to inflict damage upon the cars of a prior building. Such new cars only await their turn to be smashed up by cars of a still heavier design and less carrying capacity coming out later. It is to be hoped that a campaign of education will be brought about to prevent any cars being put together at a greater speed than that which will put the draft gears solid: Unfortunately there are a great many cars equipped only with twin-spring draft gears, which on the 40-ton loaded car would go solid with an impact speed just a little less than two miles per hour. There are a large number of such cars in use to be considered in any study of this very important phase of the problem.

It would be a good study for the transportation man to find out what percentage of switching movement he would save in his yards if he did not have to set aside damaged cars. Would be not be very much like the telephone operator who is in such a hurry that she gives the wrong number two out of five times, and as a consequence, gets so many calls that she cannot reduce her speed and so continues to make errors that are not only a source of annoyance to her but more so to her patrons? I cannot help thinking that if more time is taken in the handling of cars in switching there will be so much less time given to cutting out damaged cars that there would be little or no increase in the cost of the service.

3.—*Point of View of the Claim Department*: The stronger and stiffer the car is designed and the heavier, the more liable it is to go solid on the draft gears, and the more liable it is to bring about damage claims due to the rigidity of the car itself. Damage claims, while very small in proportion to the cost of the car repairs, bring about a great deal of friction with outside patrons and develop liability in dissatisfaction which is often of greater moment than the actual cost. The real cure for this is the educational campaign against over-speed impact.

4—*The Car Builder's Point of View*: The Car Builder, of course, desires a car so designed that it is easy to build. This is a consideration every designer should have in mind, since the simplicity in construction reflects itself in the price of the car to the owner and user, and in the cost of transportation, in that it reduces the interest and depreciation charge against the equipment. Too much study cannot be put in the design in order to increase the facilities for building along with the decreased weight.

I recently had my attention called to two cars of the same weights and approximately the same number of rivets to drive, and was told by one builder that with the same working force, twenty-five cars of one design could be delivered from the shop a day as against twenty of the other design. This is mentioned to show the value of giving attention to this feature of the design. Particularly should attention be given to the possibilities of using machine as against hand-driven rivets, not only to save in the cost of rivet driving, but in getting better driven rivets.

5—*The Specialty Man's Point of View*: These men who have felt themselves called upon to develop and sell specialties for railway cars have taken a great part in the constructive development of the car-building industry of the country. They are to be highly commended for their efforts. The car building industry, on account of the large duplication of the same design, is a wonderful field for the efforts of such men. There are a great number of these specialties exceedingly useful and they should be used, because they are helps in reducing the weight, reducing the cost and reducing the maintenance of the cars. Great care, however, must be taken in selecting them, to be sure that the designer is not being muddled by having the advantages of the specialty overstressed to the neglect of its final value as an economic device, in comparison with others, when the cost is taken into consideration. It requires a large amount of careful analysis not to fool one's self as to the real value of these devices when they are presented, as they often are, in such a pleasing and convincing manner.

The personality of some of our friends in the supply business is such that I often think they can sell anything they undertake to sell.

In general I do not believe it is possible to go to too much expense in the preparation of the design for steel freight equipment where there is such a large duplication from the same design. This is true for an individual company purchasing any large number of cars for their own use. It is true in a much larger proportion for the railways of this country, as a whole, when they can standardize cars for use on all railways.

I have always felt that the American Railway Association, Mechanical Section, could not do better than to organize an engineering department for this purpose.

Every car for which a design is to be prepared should not have simply one design furnished and passed upon, but a dozen or more qualified designers should work up a design following his own bent or views of construction, each along different lines, each bringing his design to completion, making all the necessary diagrams, showing methods of loading, weights, details of construction, estimated costs, and then these designers should themselves select either the best two or three to be finally passed upon or the best types of construction that can be put together, considering weight, cost of construction, relative strength, ease of construction and other pertinent features, and in this way get the advantage of the very best that it is possible to produce to be presented to the country at large. The engineering cost of such a method would be insignificant compared with the design to be produced and the advantages to be gained.

The final results will be that the car builders themselves will not find it necessary to maintain such large engineering forces, the cost of which enters into their overhead, which naturally has finally to be passed on to the purchaser and user of the cars.

PRESIDENT:— The paper has presented many suggestions as to what could be done in the way of betterment of freight cars, to have a better car and a car to better satisfy our patrons. I am sure there are a number here who will want to ask some questions or offer some discussion. The paper is now before you for general discussion.

MR. W. J. MEYER: I am a visitor and perhaps overstepping the limits of my privilege, but I would like to ask a question. I would like to know why, in the transition from wood to steel cars, the coupler horn was not relocated? That is, why was it not put on the sides of the coupler head so that its impact would act in the same line with the draft gear?

MR. A. B. JOHNSON: Will the use of copper-bearing steel in a car reduce the cost of painting required?

MR. N. W. STORER: I have been waiting for the real railroaders to bring out their opinions but they seem to be a little backward. There are a number of points in the paper which interested me immensely, especially the idea that the cars can be injured in classification yards. If there are any men here who are connected with the classifying of cars, I think they better get up and say something. I would if I was hammered as hard as they have been tonight. It seems to me the speaker has a pretty good case so far.

I would like to ask what bearing this will have on the length of trains. It has relieved my mind to a considerable extent to learn that the maximum damage to cars takes place in classification yards, because it seems from that fact that longer trains can be handled than we have considered possible with the present strength of draft gear. It seems that it can go up to 8,000 or 10,000 ton trains, as some of our roads have been figuring on, without increasing the draft gear materially over what it is today. I would like to ask the speaker to give us his idea of the ultimate length or tonnage of trains which the roads will come to in a period of say five or ten years, the tonnage and the speeds at which trains will be operated? It is a point of the greatest interest to men who are designing locomotives.

MR. JOHN A. PILCHER: As to the location of the coupler horn, it is right difficult after a thing has been done for a number of years by somebody else to find out just why it was done. I can only guess at it. The horn of the coupler furnishes the opening through which the lift lock passes. It is certainly not strong enough to take the blow after the draft gear has been damaged and the coupler shank upset.

As to the value of copper-bearing steel. The experiments now being conducted are of a most interesting character. There are some very old cars constructed of metal that have corroded very slowly. Since this question of copper-bearing steel has been projected into service, the material in these old cars has been analyzed and found to have the copper content. Old smokestacks that have stood for a long period have also been found to have the copper content. One of the big car building concerns in this country undertook to put copper-bearing steel in some of their passenger equipment. They have stopped it, saying they did not get the results they expected. They found that some sheets gave most magnificent service, and some pitted very badly. When they analyzed the pitted sheets, they could not find any copper. They decided that possibly it had segregated, but I suspect the truth is they did not inspect it closely enough to see that they were getting what they paid for.

The American Society for Testing Materials have for a number of years been experimenting with copper-bearing steel exposed to different weather conditions. There are three localities in which these exposures are being made, viz.: Annapolis to get the salt air; Pittsburgh, the industrial gases, and at Fort Sheridan, Illinois, for an uncontaminated district. In every case the steels that did not have any copper in them have failed. The last report I had was that not a single copper-bearing plate, whether it was iron, Bessemer or open-hearth steel, had failed, every one of them being intact. The indication is that the corrosion that takes place is very much more uniform, and the structure is very much smoother where the copper is used.

As to the question of painting in that connection, I am not prepared to make any comment on that.

The question of cars damaged by over-speed impact in classification yards has come to my attention more particularly within the last two or three years. On our own road we have a gathering, from time to time, called a "System Freight-Handling Efficiency Meeting," which is worked up by the Claim Department. I have been attending for about two years, sitting with the Committee on Rough Handling, and I hear some things. I am not speaking simply of hump yards. They probably are a little better than flat yards. A car is often run down in the classification yard and it does not go quite far enough, and the brakeman on the next switch hollers for the engineer to "sweep her out" with the next car. He attempts to do that and injures the coupler, draft gear and the car. For such a purpose the friction draft gear is not as good as the spring draft gear. The springs will re-act and start the car. In such a method of handling the car has to be hit hard enough to drive the draft gears solid before any "sweeping out" can be done. Progressive damage, not apparent to the men, is thus accumulated and a real failure later occurs.

You would be surprised to know at what low speeds of impact damage can be done when the gears go solid. Where the gear is in bad condition, or has been upset or broken, they go solid very easily. I was watching a string of cars not long ago where a light switch engine was handling a train, and I will say to you that such was the condition of the draft gears and attachments that every coupler horn on every car in the train went back solid with every movement. What brought about such a condition? It is the heavy blow it gets in the yard. The man in charge of the yard operation will do well to look carefully into this statement. He will have a chance to save a large expense.

At the Norfolk & Western coal piers at Lamberts Point, near Norfolk, dumpers are used for unloading the coal. An empty car on the dumper is knocked off and started down the incline to the switchback when it is struck by the car ascending the incline to the dumper. This movement is slow, but it has been found, even with the slow movement, that there is a very large amount of damage done in this process of operation. The man in charge of the electrical equipment at the Piers informed me that by putting a speed limit relay on the hoisting engines (which pull the cars up the incline to the dumper) in such a way as to definitely fix the limit of speed of the car as it reached the top of the incline and came in contact with the standing car on the dumper, he had very materially reduced the damages to equipment.

Some time when any of you are near a coal handling pier where cars are handled in dumping machines, most of which are operated as I have mentioned, look about you and see if you do not find a large number of broken knuckle pins and similar broken parts about the dumper, indicating the damage that is done by striking cars together on the dumper, and by running them together as they run to the empty yard from the dumper.

As to the question that has been raised as to maximum length of trains that can'be handled. The heaviest and longest train that I ever saw was about 16,000 tons. This train was composed of new cars, and there had not been sufficient time since the cars were built to damage the draft gears and coupler shanks so as to develop unresisted slack action. The train was run for the purpose of testing out special brakes. A part of this test was to be an emergency application, which was to come at some time unexpected to the many guests on the train. Many were very anxious as to the results of such an emergency application. Anxious to know something of the conditions, I stationed myself out on the train to see if I could detect just what shocks would take place. Having previously been on a very long, heavy train in first-class condition (as to unresisted slack in draft gears and connections), I was not expecting anything unusual to happen with the emergency application. When the emergency brake was applied, there were no great heavy shocks in the train. From the two experiences in connection with these very long, heavy trains, which were practically new and had no large amount of unresisted slack, I have come to the conclusion that the modern draft equipment is ample for train service, if it is not damaged by over-speed impact in yards.

On the Norfolk & Western there was recently a campaign to prevent break-in-twos, which brought about much discussion.

I took the position I am now taking. It was stated in this discussion that there was often as much as 4 inches' unresisted slack in one car, measuring backward and forward movement. When a special examination was made, as much as 5½ inches unresisted slack was found.

I do not believe any man can prophesy as to how long trains will be, or how large the cars will be. When Mr. C. A. Seley was Mechanical Engineer on the Norfolk & Western Railway, so I am told by one of the men with me now, who was with him then, he saw engines double-heading a train of cars. These engines had 25,000 pounds tractive effort, each. Mr. Seley remarked, "Who in the world can design cars strong enough with such handling as that going on." The two engines were exerting a tractive effort of 50,000 pounds. We now have single mallet steam engines on our own road having about 107,000 pounds tractive effort, and on other roads, probably 130,000 pounds. We have electric locomotives with a constant tractive effort still greater. We do not know how far developments will carry us. We will simply have to await developments.

PRESIDENT: I will ask Mr. Karl Berg whether he has something to say on this subject.

MR. KARL BERG: I find it rather difficult to mention anything that has not already been said in regard to steel car design. Among all the good points mentioned there is one that impressed me in particular, the question of standardization. That is something that has been worked at, I guess, ever since steel cars were first designed. Just now it is possibly worth considering whether too much standardization will not retard the improvement of car equipment and whether it is not possible that too much standardization in car equipment at the present time has not retarded certain developments, particularly in regard to trucks, the design of journal bearings, journal boxes and other features in connection with the truck. Is it not a fact that even now several schemes are being thought of which if adopted would entirely upset our present standards in regard to freight car trucks? It is just a thought that goes along with standardization, or rather a penalty that is paid on account of too much standardization.

MR. J. L. CUNNINGHAM: I was very much interested in the question of the design of the car as related to the earnings of the railroad. I had never appreciated the extent to which the design of the car would affect our earnings. I would like to ask what is the maximum speed at which the general run of cars should be allowed to come in contact without damage?

MR. JOHN A. PILCHER: The question of the relation of standardization to development is certainly a very pertinent one. Absolute standardization would undoubtedly mean stagnation. Therefore, those in charge of an attempt to standardize have been very careful not to bring about a condition that will, in any way, prevent development. You will notice that the statement I made in regard to trucks was that there would be a standard truck, but that does not mean that a standard truck should always remain the same. It simply means that for the time being, in interchange service, it will be recognized as a standard truck, and as such could be used in replacement on any other man's car and would be recognized by everybody as a proper replacement.

All new cars after a certain time must be built in such a way that they will take the standard truck, but it does not compel the owner to place the standard truck under them. He may use any truck that will fit, with the proviso that it must be constructed so as to give, with a certain method of assumed loading, a certain maximum fibre stress.

Axles have been standardized on that basis. Wheels have been standardized on an empirical basis. It will be possible to calculate side frames and bolsters. Brake beams have already been fixed on the same basis, that is, to come within a specific place and meet a specific strength test. The attempt has been made to avoid any hard and fast standardization that would prevent development or cut out initiative.

In regard to the question of maximum speed of contact at which cars may be put together. The great majority of the freight in this country is shipped in cars equipped with spring draft gears, which on a 40-ton loaded car, according to the tests made at Rochester, will go solid at a speed of 1.93 miles per hour. That will give a force of reaction between the cars of about 66,000 pounds. If that speed is increased only to two miles per hour, which is .07 of a mile per hour, the reaction forces will be approximately 125,000 pounds. If the same cars are put together at a speed of 2¼ miles per hour, the reaction forces will be 400,000 pounds; at 2½ miles, 650,000 pounds. All of this is derived from the tests made at Rochester, and is dependent upon the resilience of the car. This is mentioned to show how rapidly the reaction increases and on what a close margin you have to work. The resilience of the car is the salvation of the car, in a measure, but it is also one of the reasons why they are so often put together at high speed, and it is also the reason why the men operating in switching yards do not realize the damage they are doing. If the car broke like an egg, they would understand what they were doing, but the damage is progressive. Every time the cars are put together at speeds just a little more than enough to bring the draft gears solid, some damage is done. As an illustration, you have all seen a stone mason break a rock. He takes his hammer and begins to hammer on it, apparently without any effect, and after he hits it a great number of times, the rock cracks open. Which blow broke the rock, the first one or the last one?

PRESIDENT: Is there any further discussion?

MR. D. F. CRAWFOFRD: Mr. [illegible] has given us a most interesting and suggestive paper. I would therefore move that we extend to him a standing vote in appreciation of his coming here and presenting to us this instructive paper.

A rising vote of thanks was tendered the speaker for his very excellent paper.

The Chairman of the Nominating Committee, Mr. D. M. Howe, read the report of that Committee for officers for the ensuing year, as follows:

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D. F. Crawford, Vice President, Locomotive Stoker Co., Pittsburgh, Pa.

FIRST VICE PRESIDENT

George D. Ogden, Traffic Manager, Pennsylvania System, Pittsburgh, Pa.

SECOND VICE PRESIDENT

A. Stucki, Engineer, Pittsburgh, Pa.

SECRETARY

J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa.

TREASURER

F. H. Stark, Superintendent Freight Car Repairs, P. & L. E. R. R. Co., Pittsburgh, Pa.

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D. J. Redding, Assistant S. M. P., Pittsburgh & Lake Erie R. R. Co.

F. R. McFeatters, General Superintendent, Union R. R. Co.

A. G. Mitchell, Secretary, Association of Transportation Officers of the Pennsylvania System.

F. M. McNulty, Rosslyn Farms, Carnegie, Pa.

J. G. Code, Pittsburgh, Pa.

D. M. Howe, Railway Supplies.

J. A. Spielmann, Assistant to General Supt., B. & O. R. R.

H. H. Maxfield, General Supt. M. P., Pennsylvania R. R. Co.

Frank J. Lanahan, President, Fort Pitt Malleable Iron Co.

Samuel Lynn, Master Car Builder, Pittsburgh & Lake Erie R. R. Co.

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E. J. Searles, Schaefer Equipment Co.

G. W. Wildin, General Manager, Westinghouse Air Brake Co.

E. A. Johnson, General Sales Manager, Duff Manufacturing Co.

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F. G. Minnick, Assistant General Manager, Pittsburgh & Lake Erie R. R. Co.

H. E. Chilcoat, Manager, Clark Car Co.

J. A. Ralston, Mechanical Engineer, Union R. R.

W. J. Murphy, General Boiler Foreman, Pennsylvania System.

J. L. Cunningham, Supt. M. P., Pennsylvania R. R.

A. D. Chittenden, Supt. Transportation, B. & L. E. R. R.

ENTERTAINMENT COMMITTEE

E. Emery, Railway Supplies, Chairman.

Henry F. Gilg, Sales Mgr., Penn Iron & Steel Co.

Jos. H. Kummer, Supt. of Orders, Fort Pitt Malleable Iron Co.

RECEPTION COMMITTEE

F. H. Freshwater, Sales Agent, Pressed Steel Car Co., Chairman
J. L. Smith, General Foreman, P. & L. E. R. R. Co.
Harry B. Kelly, Road Fore. of Engines, P. & L. E. R. R. Co.
E. V. Williams, Supt. M. P., B. R. & P. Ry. Co.
H. M. Wolf, Road Fore. of Engines, P. & L. E. R. R. Co.
S. E. Van Vranken, Purchasing Agent, Locomotive Stoker Co.

SUBJECT COMMITTEE

John F. Lent, President, Liberty Transit Company, Chairman.
Charles Orchard, Traffic Dept., Carnegie Steel Co.
John B. Wright, Asst. Dist. Mgr., Westinghouse Air Brake Co.
Wm. J. Knox, Mechanical Engr., B. R. & P. Ry. Co.
E. B. DeVilbiss, Master Mechanic, Pennsylvania R. R.

Upon motion duly seconded, the report of the Nominating Committee was accepted and the Secretary instructed to forward the record of ballots to the members by mail, it being understood that any member of the Club is privileged to nominate any person for an office if he is not satisfied with the nominations of the Committee.

There being no further business, upon motion the meeting adjourned.

J. D. CONWAY, Secretary.

In Memoriam

Edward Kerr
Died May 20th, 1922

Charles S. Rea
Died August 1st, 1922

Joseph H. McConnell
(Date unknown)

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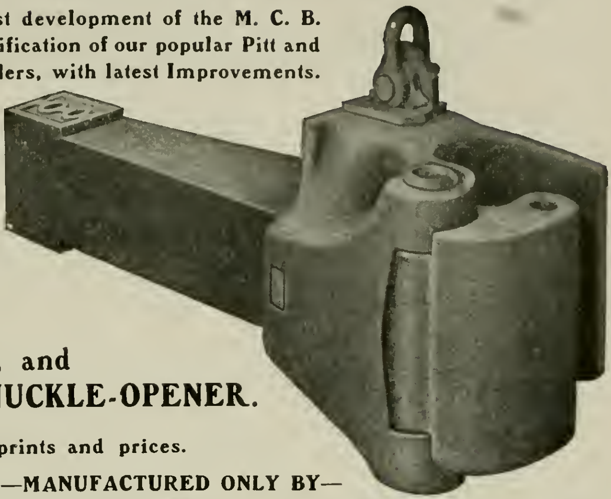

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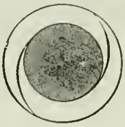

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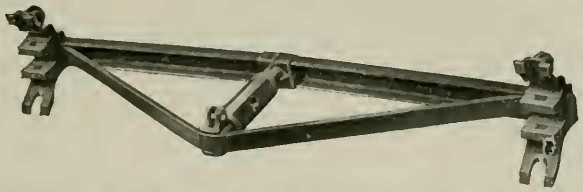

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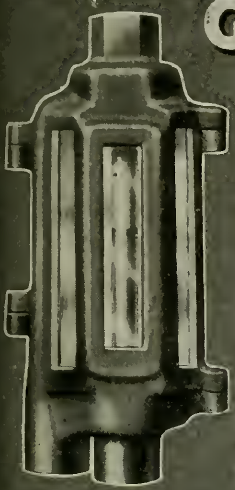

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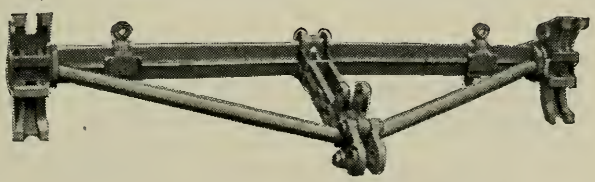

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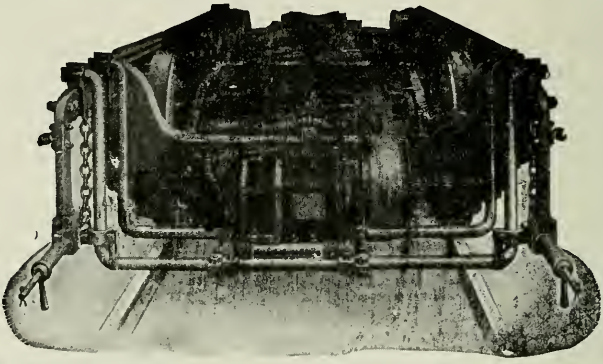

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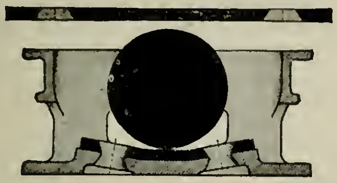

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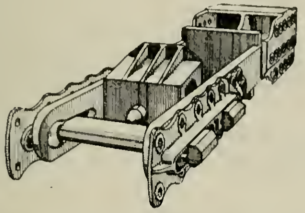

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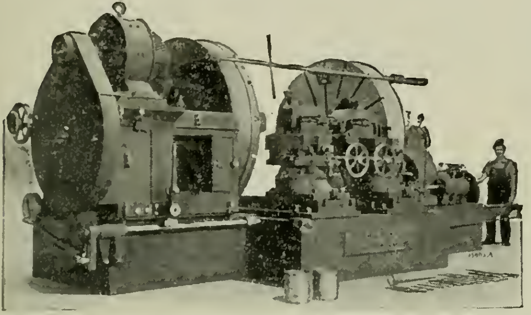

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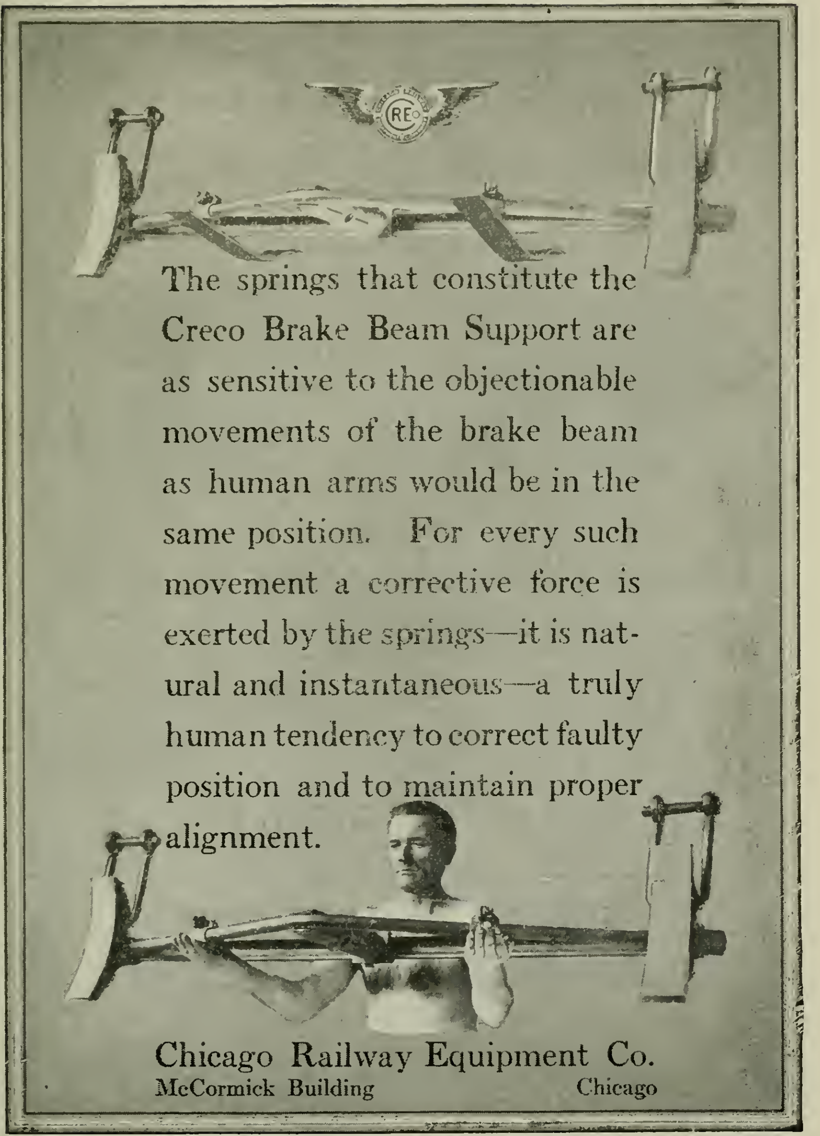

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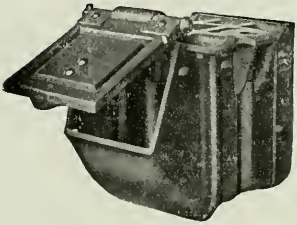

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Vol. XXI
No. 9

Pittsburgh, Pa., Oct. 26, 1922.

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Logan, F. M.
Lohr, Allen W.
Long, H. P.
Long, R. M.
Lynn, Samuel
Lytle, H. I.
Maliphant, C. W.
Martin, W. H.
Matchett, H. K.
Maxfield, H. H.
Meeker, H. B.
Merscher, John
Meschter, E. F.
Meyers, John H.
Meyers, John M.
Millar, C. W.
Milliken, J.
Miser, C. H.
Mitchell, T. J.
Moir, W. B.
Montgomery, J. L.
Moran, J. V.
Murphy, E. S.
Myers, W. H.
McConn, G. E.
McDermitt, W. W.

McDowell, D. W.
McGovern, J. C.
McGowan, C. H.
McKee, D. L.
McKee, Fred. C.
McKinstry, C. H.
McNamee, W. L.
McNulty, F. M.
Nall, R. M.
Neal, J. T.
Nelson, W. O.
Newman, J. F.
Nicodemus, E. H.
Orchard, Chas.
Orr, W. M.
Painter, Joseph
Parke, F. H.
Parker, W. G.
Passino, F. J.
Patmor, H. F.
Patterson, J. E.
Pennington, F. W.
Phillips, W. H.
Pleger, F. W.
Pollock, Wm.
Pratt, I. D.
Price, W. F.
Proft, J. W.
Prouty, E.
Quinn, J. M.
Rabold, W. E.
Ralston, J. A.
Rankin, B. B.
Rauschart, E. A.
Redding, D. J.
Redman, J. Thos.
Reeve, Geo.
Renshaw, W. B.
Rice, D. S.
Riddile, F. C.
Richardson, H. R.
Rick, R. C.
Robbins, F. S.
Robinson, R. L.
Rogers, W. R.
Roney, H. E.
Roth, P. J.
Ruben, J. W.
Rumbarger, F. A.
St. Clair, Chas. B.
Saltic, Thos.
Sattley, E. C.
Schaefer, Fred.
Schrecongost, C.
Searles, E. J.
Severn, A. B.
Shannon, D. E.
Sheridan, T. F.
Shultz, Geo. J.
Skuce, C. G.
Smith, F. C.
Smith, Fred. M.
Smythe, W. C.
Snyder, Jos.
Snyder, W. H.
Spielmann, J. A.
Spindler, D. G.
Stahlman, M. C.
Staman, H. Z., Jr.
Stamets, Wm. K.
Stark, F. H.
Stauffer, A. H.
Stevens, L. V.
Stevenson, W. J.
Stoller, Karl M.
Straub, W. C.
Stucki, A.
Sullivan, M. J.
Summerfield, D.
Sutter, C.
Sykes, Arthur
Taylor, H. G.
Temple, H. H.
Ternent, H. J.
Thiele, Chas. F.
Thomas, F. B.
Thomas, G. N.
Tracey, J. B. A.
Tucker, J. L.
Uhler, J. L.
VanVranken, S. E.
Watkins, D. R.
Weaver, J. R.
Weaverling, C. J.

Webster, H. D.
White, A. B.
White, C. C.
Williamson, J. A.
Willoughby, F. R.
Wilson, W. J.
Winell, K. O.
Wright, John B.
Zimmerman, S.

VISITORS

Able, A. W.
Adler, A. C.
Ainor, J. C.
Allerton, H. N.
Allison, J. H.
Anderson, A. C.
Andrews, C. S.
Austin, F. S.
Bailey, J. M.
Baker, J. B.
Barkley, J. R.
Bart, J. G.
Bell, J. G.
Bennett, T. W.
Bishop, M. T.
Bochert, Carl G.
Bodell, C.
Bomes, C. G.
Borden, W. A.
Bosau, C. J.
Bosley, N. D.
Brown, Wm. H.
Brush, Chas. C.
Burns, C. M.
Carner, P. J.
Carway, F.
Charlton, R. J.
Cherry, J. T.
Christy, Wm.
Clarke, Chas.
Clarke, J. H.
Clifford, E. T.
Clopton, E. J.
Coburn, R. G.
Cody, P. C.
Colclaser, L. A.
Collins, H. M.
Connelli, J. V.
Cornwall, H. L.
Corson, C. E.
Cozad, W. S.
Cunningham, T. J.
Daniels, Geo. L.
Darr, Geo. A.
Davin, Chas. J.
Davis, A. R.
Dayton, O. F.
Dickinson, F. H.
Diers, Henry
Dillon, John
Donahue, E. V.
Donahue, T. J.
Ebert, C. S.
Eckert, Chas. R.
Egly, M. J.
Elk, E. C.
Elkin, F. C.
Emery, Frank
Ensminger, E.
Estell, J. A.
Felton, F.
Fields, A. C.
Fields, D. S.
Forger, F. G.
Fox, Geo. W.
Fuerst, H. F.
Frauenheim, H. T.
Fults, J. J.
Gable, M. G.
Galbraith, R. M.
Garber, W. R.
Gilg, E. H.
Gillen, J. B.
Gillespie, D. D.
Goldstrom, G. E.
Gonzcon, J. E.
Greene, John H.
Greene, W. J.

Gregory, W. H.
Gross, Jas. C.
Gush, Chas. M.
Hagerty, J. W.
Hahn, H. A.
Haller, N. M.
Hallstein, G. W.
Hamerly, W. H.
Hanna, J. C.
Harrison, E. A.
Hayes, J. E.
Helbling, C. P.
Henck, Geo.
Hepburn, M. J.
Hogg, Francis
Hoke, L. E.
Hollingsworth, C. N.
Holmes, H. B.
Hovey, O. E.
Hovey, O. W.
Howe, Ed.
Howe, M. E.
Howells, H. C.
Hughes, Wm.
Hummel, C. E.
Jackson, A. M.
Jackson, Chas.
Jex, W. S.
Johnson, E. R.
Jones, David
Joseph, A. M.
Joyce, T. J.
Jungbluth, H.
Kammer, Walter
Kaschuck, M. J.
Kasnitz, Jess
Keetley, Robert
Kelly, F. J.
Keightly, Fred.
Kennedy, E.
King, E.
King, J. W.
Koehler, P. A.
Kraus, R. E.
Latusick, J. F.
Laughlin, M. J.
Laurent, A. J.
Laurent, Jos. A.
Lee, D. H.
Leonard, C. W.
Lepper, C. W.
Lilley, C. L.
Logue, J. W.
Long, Walter
Loughbridge, H. W.
MacMillan, E. P.
Magim, J. D.
Mahan, W. C.
Marko, P.
Marlow, G. A.
Meyer, A. L.
Meyer, F. N.
Meyer, Fred
Miles, H. E.
Miller, A. E.
Miller, Geo. H.
Miller, H. L.
Miller, Jos. L.
Mills, C. C.
Montgomery, W. E.
Moreland, E. L.
Morris, J. H.
Munn, Alex D.
Myers, Arnold
McDonough, J. V.
McDowell, T. E.
McEldowney, R. W.
McGier, C. T.
McIntyre, R. C.
McMillan, Alex
McMichael, J. S.
Nelson, W. M.
Newman, M. F.
Nieman, H. L.
Niklaus, C. G.
Nill, J. G.
Noble, J. A.
Oier, J. E.
O'Neill, J. T.
Pflaum, A. H.
Phlegar, A. B.
Pickford, J. W.
Pinski, David
Raum, J. A.

Redman, C. E.
Reed, C. R.
Rehlin, T. G.
Reynolds, D. E.
Ringer, E. C.
Robbins, A. J.
Robeck, G. B.
Roberts, H. C.
Rogers, Robert
Rohyans, A. V.
Roy, W. H.
Rudd, Paul S.
Rushneck, G. L.
Russell, W. E.
Ryce, E. S.
Salisbury, Wm.
Saxman, Harry
Schoenberger, R. L.
Schweitzer, A. C.
Schuck, G. C.
Scott, J. C.
Searight, E. A.
Seewald, J. H.
Seif, L. P.
Shields, C. R.
Simpson, Robt.
Skiles, E. C.
Smense, R. E.
Smith, Ernest
Smith, M. A.
Smith, P. E.
Smith, S. M.
Smith, Sion B.
Smith, W. J.
Sneck, Harry
Snyder, J. C.
Stenson, G. A.
Stoples, J. P.
Streib, J. F.
Stothers, C. J.
Stump, Howard
Supinger, H. B.
Sushinski, C. J.
Swartswelder, H. S.
Theisen, W. C.
Thomas, B. K.
Thomas, Jack
Thompson, W. E.
Turner, J. A.
Warnock, W. R.
Warrensford, Fred
Weaver, E. H.
Wehner, G. E.
Wehner, W. G.
Werner, H.
West, J. W.
Whittingham, D. B.
Wheatley, Wm.
White, A. A.
Whyte, J. P.
Widmeier, L.
Winge, Geo. A.
Wolfe, Ralph
Wood, W. E.
Yearich, R. O.
Young, W. K.
Zugan, John D.

The call of the roll was dispensed with, the record of attendance being had through the registration cards.

The reading of the minutes of the last meeting was dispensed with as they are to appear in printed form.

The Secretary read the following list of applications for membership:

Austin, Francis S., Gen. Sales Mgr., Carbo-Oxygen Co., Benedum Trees Bldg., Pittsburgh, Pa. Recommended by J. D. Conway.

Bailey, John M., Vice Pres., Standard Inspection Co., 954 Century Bldg., Pittsburgh, Pa. Recommended by W. C. Howe.

Balderoni, Albert J., Contractor, 35 Donner Ave., Monessen, Pa. Recommended by S. A. Damore.

Cady, P. C., Railway Supplies, 133 Greenwich Street, New York City. Recommended by E. Emery.

Cronin, M. F., Clerk, Div. Accountants Dept., Pennsylvania System, 811 Rebecca Avenue, Wilkinsburg, Pa. Recommended by C. B. Gray.

Daniels, Geo. L., Estimator, Pressed Steel Car Co., 84 N. Harrison Avenue, Bellevue, Pa. Recommended by Howard L. Cunningham.

Gemeiner, Wm. J., Commercial Agent, D. L. & W. R. R., 428 Park Bldg., Pittsburgh, Pa. Recommended by E. Emery.

Harding, Sherman A., Sales Mgr., Consolidated Machine Tool Corp'n., 1915 Oliver Bldg., Pittsburgh, Pa. Recommended by Wm. H. Connell, Jr.

Laurent, Jos. A., Foreman Finishing Dept., Fort Pitt Malleable Iron Co., 1111 Church Avenue, McKees Rocks, Pa. Recommended by F. J. Lanahan.

Lowstuter, George W., Carman, P. & L. E. R. R., Monessen, Pa. Recommended by S. A. Damore.

Miller, James M., Sergeant Police, Pennsylvania System, 3213 War Street, Pittsburgh, Pa. Recommended by Gomer A. Gibson.

Morris, J. H., Fuel Supervisor, B. R. & P. Ry., 704 Mahoning Street, Punxsutawney, Pa. Recommended by A. B. White.

Noble, Jesse A., Shop Fore., P. & L. E. R. R., Engr. Dept., Box 535, McKees Rocks, Pa. Recommended by D. L. McKee.

Rogers, Robert, Sales Agent, American Car & Foundry Co., Farmers Bank Bldg., Pittsburgh, Pa. Recommended by J. D. Conway.

Santell Ralph F., Trainman, P. & L. E. R. R., 1048 Morgan Avenue, Monessen, Pa. Recommended by S. A. Damore.

Staples, Julian P., Mgr. Rwy. Equip. Div. Sales, Macbeth Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa. Recommended by Jos. H. Kummer.

Widmeier, L. W., Dist. Sales Mgr., American Flexible Bolt Co., 340 Leader News Bldg., Cleveland, Ohio. Recommended by Chas. E. Hale.

PRESIDENT: As soon as these applications have been approved by the Executive Committee, the gentlemen will become members upon payment of the year's dues.

As this is the Annual Meeting, the next order of business is the presentation of the Annual Reports of the Secretary and the Treasurer. We will first hear the report of the Secretary.

SECRETARY'S REPORT.

Pittsburgh, Pa., October 26th, 1922.

To the Officers and Members of
The Railway Club of Pittsburgh.

Gentlemen:

The following is a summary of membership and financial statement for the fiscal year ended October 26th, 1922.

MEMBERSHIP.

Reported last year	1,158	
Received into membership during the year	250	
Reinstated	1	
		1,409
Suspended, non-payment of dues	190	
Resigned	35	
Loss of address	19	
Died	11	
		255
Present membership		1,154

Of the above membership five are honorary. They are D. C. Buell, Samuel O. Dunn, Julian Kennedy, Rev. Samuel McCauley Lindsay and John A. Penton.

NAMES OF DECEASED MEMBERS

J. H. McConnell, date of death not known. The following died during 1921-1922: D. H. Amsbary, J. McF. Easton, Louis Follet, Joseph P. Grove, Edward Kerr, F. V. McDonnell, C. S. Prosser, C. S. Rea, J. B. Rider and B. E. D. Stafford.

FINANCIAL

Receipts

In hands of treasurer at close of last year	$4,912.15	
From dues	2,901.00	
From advertisements	1,516.80	
For sale of tickets, Smoker Oct. 27, 1921	319.00	
From sale of Proceedings	14.00	
From incidentals	22.00	
From interest, Liberty Bonds, etc	152.97	
Total Receipts		$9,837.92

Disbursements

Printing Proceedings, notices, mailing, etc	$2,448.59	
Hall, luncheon, cigars, etc., for meetings	707.28	
Reporting proceedings of meetings	180.00	
Salary of Secretary and advertising expenses	751.68	
Luncheon, entertainment, etc., Smoker Oct. 27, 1921	843.28	
Floral pieces	50.00	
Premium on bond, Treasurer and Secretary	17.50	
Moving pictures	55.00	
Messenger service	14.00	
Affidavits	1.50	
Annual dues, Ass'n. of Railway Club Secretaries	15.00	
Attending Railway Club Secretaries' meeting, New York	43.00	
Total disbursements		5,126.83
Net balance		$4,711.09

Cash is made up of $1,711.09 and $3,000.00 in Liberty Bonds.

J. D. CONWAY, Secretary.

Approved: L. H. TURNER, Chairman.
D. J. REDDING
F. R. McFEATTERS
A. G. MITCHELL
F. M. McNULTY
J. G. CODE
D. M. HOWE
J. A. SPIELMANN
H. H. Maxfield
FRANK J. LANAHAN
Executive Committee.

Upon motion the report was accepted and directed to be inserted in the minutes of the meeting.

PRESIDENT: Next we will hear the report of the Treasurer.

TREASURER'S REPORT.

Pittsburgh, Pa., October 26th, 1922.

To the Officers and Members of
The Railway Club of Pittsburgh.

Gentlemen:

I hereby submit Treasurer's Report for year ended October 26th, 1922:

ON HAND AND RECEIPTS

On hand October 27th, 1921, including three $1,000.00 Liberty Bonds	$4,912.15	
Received from Secretary during year	4,772.80	
Interest on Bonds and Bank Balance	152.97	
Total		$9,837.92

DISBURSEMENTS.

Paid on Secretary's Vouchers, 394 to 426 inclusive		5,126.83
Balance October 26th, 1922		$4,711.09

RESOURCES.

Three Liberty Bonds, $1.000.00 each	$3,000.00
Cash in bank	1,711.09
Total	$4,711.09

F. H. STARK, Treasurer.

Approved: L. H. TURNER, Chairman.

D. J. REDDING	J. G. CODE
F. R. McFEATTERS	D. M. HOWE
A. G. MITCHELL	J. A. SPIELMANN
F. M. McNULTY	H. H. Maxfield

FRANK J. LANAHAN
Executive Committee.

Upon motion the report was accepted and directed to be inserted in the minutes of the meeting.

PRESIDENT: We will now hear the report of the election of Officers from the Tellers.

MR. D. J. REDDING: I will ask Mr. Maxfield to read the report.

MR. H. H. MAXFIELD: Because the voice of the Chairman is somewhat out of commission, I have the honor of presenting the Report of the Tellers of Election, as follows:

TELLERS' REPORT.

PRESIDENT—D. F. Crawford.

FIRST VICE PRESIDENT—George D. Ogden.

SECOND VICE PRESIDENT—A. Stucki.

TREASURER—F. H. Stark.

SECRETARY—J. D. Conway.

EXECUTIVE COMMITTEE—L. H. Turner, Chairman; D. J. Redding, F. R. McFeatters, A. G. Mitchell, F. M. McNulty, J. G. Code, D. M. Howe, J. A. Spielmann, H. H. Maxfield, Frank J. Lanahan, Samuel Lynn.

FINANCE COMMITTEE—E. C. Sattley, Chairman; C. O. Dambach, E. J. Searles, G. W. Wildin, E. A. Johnson.

MEMBERSHIP COMMITTEE—A. Stucki, Chairman; F. G. Minnick, H. E. Chilcoat, J. A. Ralston, W. J. Murphy, J. L. Cunningham, A. D. Chittenden.

ENTERTAINMENT COMMITTEE—E. Emery, Chairman; Henry F. Gilg, Jos. H. Kummer.

RECEPTION COMMITTEE—F. H. Freshwater, Chairman; J. L. Smith, Harry B. Kelly, E. V. Williams, H. M. Wolf, S. E. VanVranken.

SUBJECT COMMITTEE—John F. Lent, Chairman; Chas. Orchard, John B. Wright, Wm. J. Knox, E. B. DeVilbiss.

Upon motion duly seconded and carried, the election was made unanimous.

PRESIDENT: At this time I am sure the members would like to hear from the newly elected Officers. Therefore I will ask Mr. Crawford to present himself.

MR. D. F. CRAWFORD: Gentlemen of the Railway Club of Pittsburgh:—I am sure I appreciate the confidence you have shown in me by casting the number of ballots that unanimously elected me to be the President of this Club. I assure you I shall do everything I possibly can to carry on the high standard that has been set for the Railway Club of Pittsburgh by the Officers who have preceded me. I request your earnest and hearty co-operation to make our Club at least as successful as it has been and if there is room for improvement, let us strive to obtain it.

PRESIDENT: Is the First Vice President, Mr. George D. Ogden, in the room? He was here a short time ago. In his absence I will call upon Mr. Stucki, the Second Vice President, the only man who has ever been elected to two offices in the Club at the same time—Second Vice President and Chairman of the Membership Committee, a responsible post which he has filled for so many years and in such an acceptable manner that the members were unwilling to relieve him from that important post.

MR. A. STUCKI: Gentlemen, I am surprised that you picked me for this job, especially in view of the fact that there are so many others far more able in this line than I am. Possible you thought that there is very little for the Second Vice President to do, which is true. I am one of the Charter Members of this Club and I am very proud of it, without, however, claiming any special credit in this respect. But I have been a very enthusiastic member ever since and I always attend the meetings when I am in the city and let me tell you right here that I have never gone home from a meeting without the satisfaction of having had a good time and of having learned something besides. This habit I kept up to this day, after twenty years.

With all this in mind, I consider it an especial honor that you should elect me to this office and for this and your confidence in me, gentlemen, I thank you.

PRESIDENT: The remainder of the members elected have all been re-elected with the exception of Mr. Emery, the Chairman of the Entertainment Committee, and he has been serving as the Chairman of that Committee for the latter part of the past year. I will not call on the other officers elect for we have something that will more interest you now and I will turn you over to the tender mercies of Mr. Emery.

Before doing so I wish to express to the members of this Club and to its Officers my grateful appreciation of their hearty and never-failing support during the year of my incumbency as your President. Like Mr. Stucki, I did not have very much to do. Whatever success has been realized during my administration has been due to the enthusiasm and the hard work of the Officers and Committees. And I want to say that if my successor gets the same support from them that I have had during the past year he will not find very much to do, either. May I bespeak for Mr. Crawford that same assistance and support and co-operation that I have received.

Now, if there is no further business, I will turn the meeting over to the Chairman of the Entertainment Committee, Mr. E. Emery.

MR. D. J. REDDING—Just a moment. I have a painful duty to perform and I must perform it. It is customary when the President retires from office to present to him some token of regard so that he may know that he has been President and that he may show to his friends in future time to prove that he held some important office in his life. And we are going to make an example of you right now.

We tried to find out what would be most suitable to surprise you with, and finally come to the conclusion that a man in your line of work needed more than anything else to have a watch to keep track of him. So we secured what we consider a very beautiful watch. In order that you may not lose the watch, we have a beautiful chain to fasten it on with. And, on the chain is an emblem of several orders that we have reason to believe you will recognize. On the other end of the chain, we have a beautiful little knife to keep it from falling out of your pocket. If you think of anything else you could use, name it.

MR. L. C. BIHLER: How about a cork screw?

MR. D. J. REDDING: We had a little money left, so in order that everybody might know who this distinguished gentleman is as he goes through life, we put a headlight on him. We have a very beautiful headlight to adorn his necktie. In order that the members may see just how much we think of the retiring president, those who wish to may file forward and view the remains. If there is any fault to be found with this equipment, we know where we can go and get some more. I do not want to pass this out through the audience, for it is really valuable. But, you may see it here, and any time you hold up Sam Lynn in the future, you can get the time and light your cigar at the headlight and have all the fun you want with it.

I take very great pleasure in turning this over to you, Mr. Lynn, because I don't like to carry it around. There is too much value attached to it. Here are the jewelry and the boxes and all the paraphernalia that goes with it.

PRESIDENT LYNN: Mr. Redding and Fellow Members of the Railway Club: I am not going to attempt to make a speech as that is not in my line, but I want to make some expression of my feelings for these beautiful gifts and I shall always appreciate them on account of the association connected with them and they will also be a constant reminder of the many delightful evenings I have spent in our Railway Club and particularly during the past year, and the many friendships that have been formed on account of my being connected with your Club. I want to particularly emphasize this feature on account of the honor you gentlemen have bestowed upon me during the past year by electing me as your president, as the office of President of this Club is an honor which anyone should be proud of.

I intimated a short time ago that most of the work had been performed by the other Officers and the various committees and the work was done so well that there was very little left for the President to do, and for that reason I want to say again that the conditions during the year have been for me at least, most pleasant and I feel sure that the different officers who have been elected tonight, will give to the new President the same loyal support that has been accorded me during the past year and that this Club will continue to grow and prosper as it has done through the many years since its organization. I want to thank you one and all for these beautiful gifts.

Mr. Emery will now take charge of the meeting.

A very brilliant and enjoyable programme of entertainment followed, after which a buffet lunch was served.

J. D. CONWAY, Secretary.

CONSTITUTION

ARTICLE I.

The name of this organization shall be "THE RAILWAY CLUB OF PITTSBURGH."

ARTICLE II.

OBJECTS

The objects of this Club shall be mutual intercourse for the acquirement of knowledge, by reports and discussion, for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men employed in railway work and kindred interests.

ARTICLE III

MEMBERSHIP

SECTION 1. The membership of this Club shall consist of persons interested in any department of railway service or kindred interests, or persons recommended by the Executive Committee upon the payment of the annual dues for the current year.

SEC. 2. Persons may become honorary members of this Club by a unanimous vote of all members present at any of its regular meetings, and shall be entitled to all the privileges of membership and not be subject to the payment of dues or assessments.

ARTICLE IV.

OFFICERS

The officers of this club shall consist of a President, First Vice-President, Second Vice-President, Secretary, Treasurer, Finance Committee consisting of five members, Membership Committee consisting of seven members, Entertainment Committee consisting of three members, Reception Committee consisting of six members, Subject Committee consisting of five members, and an Elective Executive Committee of three or more members, who shall serve a term of one year from the date of their election, unless a vacancy occurs, in which case a successor shall be elected to fill the unexpired term.

ARTICLE V.

DUTIES OF OFFICERS

SECTION 1. The President shall preside at all regular or special meetings of the Club and perform all duties pertaining to a presiding officer; also serve as a member of the Executive Committee.

SEC. 2. The First Vice President, in the absence of the President, will perform all the duties of that officer; the Second Vice-President, in the absence of the President and First Vice-President, will perform the duties of the presiding officer. The First and Second Vice-President shall also serve as members of the Executive Board.

SEC 3. The Secretary will attend all meetings of the Club or Executive Committee, keep full minutes of their proceedings, preserve the records and documents of the Club, accept and turn over all moneys received to the Treasurer at least once a month, draw cheques for all bills presented when approved by a majority of the Executive Committee present at any meetings of the Club, or Executive Committee meeting. He shall have charge of the publication of the Club Proceedings and perform other routine work pertaining to the business affairs of the Club under the direction of the Executive Committee.

SEC. 4. The Treasurer shall receipt for all moneys received from the Secretary, and deposit the same in the name of the Club within thirty days in a bank approved by the Executive Committee. All disbursements of the funds of the Club shall be by cheque signed by the Secretary and Treasurer.

SEC. 5. The Executive Committee will exercise a general supervision over the affairs of the Club and authorize all expenditures of its funds. The elective members of this Committee shall also perform the duties of an auditing committee to audit the accounts of the Club at the close of a term or at any time necessary to do so.

SEC. 6. The Finance Committee will have general supervision over the finances of the Club, and perform such duties as may be assigned them by the President or First and Second Vice-Presidents.

SEC. 7. The Membership Committee will perform such duties as may be assigned them by the President or First and

Second Vice-Presidents, and such other duties as may be proper for such a committee.

SEC. 8. The Entertainment Committee will perform such duties as may be assigned them by the President or First and Second Vice-Presidents, and such other duties as may be proper for such a committee.

ARTICLE VI.

ELECTION OF OFFICERS

SECTION 1. The officers shall be elected at the regular annual meeting as follows, except as otherwise provided for:

SEC. 2. Printed forms will be mailed to all the members of the Club, not less than twenty days previous to the annual meeting, by the elective members of the Executive Committee. These forms shall provide a method, so that each member may express his choice for the several offices to be filled.

SEC. 3. The elective members of the Executive Committee will present to the President the names of the members receiving the highest number of votes for each office, together with the number of votes received.

SEC. 4. The President will announce the result of the ballot and declare the election.

SEC. 5. Should two or more members receive the same number of votes, it shall be decided by a vote of the members present, by ballot.

ARTICLE VII.

AMENDMENTS

Amendments may be made to this Constitution by written request of ten members, presented at a regular meeting and decided by a two-thirds vote of the members present at the next regular meeting.

BY-LAWS

ARTICLE I

MEETINGS

SECTION 1. The regular meetings of the Club shall be held at Pittsburgh, Pa., on the fourth Thursday of each month, except June, July and August, at 8 o'clock P. M.

SEC. 2. The annual meeting shall be held on the fourth Thursday of October each year.

SEC. 3. The President may, at such times as he deems expedient, or upon request of a quorum, call special meetings.

ARTICLE II.

QUORUM

At any regular or special meeting nine members shall constitute a quorum.

ARTICLE III.

DUES

SECTION 1. The annual dues of members shall be Two Dollars, payable in advance on or before the fourth Thursday of September each year.

SEC. 2. The annual subscription to the printed Proceedings of the Club shall be at the published price of One Dollar. Each member of the Club shall pay for both dues and subscription. Dues and subscription paid by members proposed at the meetings in September or October shall be credited for the following fiscal year.

SEC. 3. At the annual meeting members whose dues and subscription are unpaid shall be dropped from the roll after due notice mailed them at least thirty days previous.

SEC. 4. Members suspended for non-payment of dues shall not be reinstated until all arrearages have been paid.

ARTICLE IV.

ORDER OF BUSINESS

1—Roll call.

2—Reading of the minutes.

3—Announcements of new members.

4—Reports of Committees.

5—Communications, notices, etc.

6—Unfinished business.

7—New business.

8—Recess.

9—Discussion of subjects presented at previous meeting.

10—Appointment of committees.

11—Election of officers.

12—Announcements.

13—Financial reports or statements.

14—Adjournment.

ARTICLE V.

SUBJECTS—PUBLICATIONS

SECTION 1. The Subject Committee will provide the papers or matter for discussion at each regular meeting.

SEC. 2. The proceedings or such portion as the Executive Committee may approve shall be published (standard size, 6x9 inches) and mailed to the members of the Club or other similar clubs with which exchange is made.

ARTICLE VI.

The stenographic report of the meetings will be confined to resolutions, motions and discussions of papers unless otherwise directed by the presiding officer.

ARTICLE VII.

AMENDMENTS

These By-Laws may be amended by written request of ten members, presented at a regular meeting, and a two-thirds vote of the members present at the next meeting.

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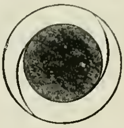

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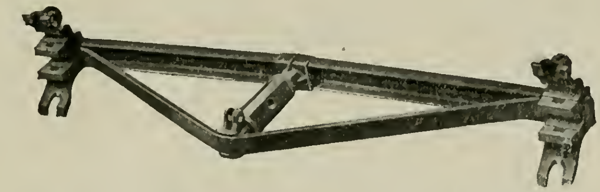

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